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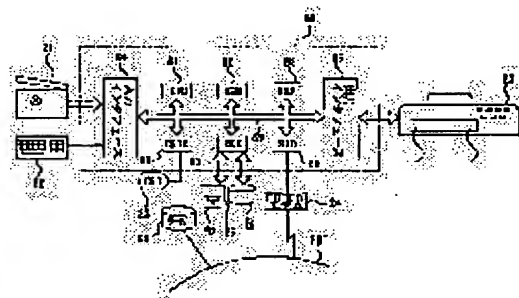
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(54) PRINTING APPARATUS, PRINTING METHOD, AND RECORDING MEDIUM

(57)Abstract:

PROBLEM TO BE SOLVED: To improve a printing quality of images including figures, characters and the like by judging the presence/absence of dot formation based on pixel gradation values, reloading the judge result so as to form small dots for outline pixels, and forming dots of each size.

SOLUTION: The printing apparatus has a color scanner 21 and a color printer 20 connected to a computer 80. A predetermined program is loaded to the computer 80, whereby printing is executed. A color original is converted by the color scanner 21 to color image data recognizable by the computer 80, and then input to the computer 80. The computer 80 converts the color image data to data printable by the printer and outputs to the color printer 20. The conversion result of the image data is output as the image data printable by the printer to the color printer 20. The color printer 20 forms ink dots of each color on printing papers. A quality of print images can be improved accordingly.



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CLAIMS

[Claim 1]

The airline printer which drives this head and prints an image while it has the head which can form two or more kinds of dots which are characterized by providing the following, and from which magnitude differs and horizontal scanning and vertical scanning are performed A dot formation decision means to judge the formation existence of said dot based on the gradation value of the pixel which constitutes said image A decision result storage means to memorize this decision result A profile pixel extract means to extract the pixel which constitutes the profile about the configuration included in said image the decision result rewriting means which rewrites said memorized dot formation decision result so that a small predetermined dot may be formed in this profile pixel, and the dot means forming which forms the dot of each of said magnitude based on this rewriting **** decision result

[Claim 2] It is the airline printer which is a means to compare with a predetermined threshold the gradation value of each pixel which constitutes this group by making into a group two or more pixels by which it is an airline printer according to claim 1, and said profile pixel extract means adjoins a main scanning direction, and to extract said profile pixel based on this comparison result and predetermined relation.

[Claim 3] The airline printer which drives this head and prints an image while it has the head which can form two or more kinds of dots which are characterized by providing the following, and from which magnitude differs and horizontal scanning and vertical scanning are performed A low resolution-ized means to summarize two or more pixels which adjoin among the pixels which constitute said image to a large pixel based on predetermined relation, and to express said image by this large pixel A dot formation decision means to judge the existence of the dot which should be formed in this large pixel based on the gradation value of this large pixel A decision result storage means to memorize this decision result A profile pixel extract means to extract the large pixel which constitutes the profile about the configuration included in said image, So that the dot of a profile dot decision means to determine the magnitude of the dot which should be formed in this profile pixel, and the magnitude this determined as this profile pixel may be formed based on the gradation value of two or more of said pixels summarized to this profile pixel said decision result rewriting means which rewrites the decision result of the memorized dot formation, and the dot means forming which forms the dot of each of said magnitude based on this rewriting **** decision result

[Claim 4] It is an airline printer according to claim 3. The dot of the predetermined magnitude in the dot in which said formation is possible it is the dot which shifts a dot formation location in the predetermined direction, and is set up to other dots. Said profile dot decision means The airline printer which is a means to determine that the dot of said predetermined magnitude is formed to analyze the gradation value distribution of two or more pixels summarized to said profile pixel, and for the direction in which the gradation value is partial spread said predetermined direction, abbreviation, etc.

[Claim 5] It is an airline printer according to claim 3. Said low resolution-ized means It is a means to summarize said pixel to a main scanning direction. The dot of the predetermined magnitude in the dot in which said formation is possible It is the dot which shifts a dot formation

location to a main scanning direction, and is set up to other dots. Said profile dot decision means The airline printer which is a means to determine that the dot of said predetermined magnitude is formed to analyze the gradation value distribution of each smallness pixel which divided said profile pixel and was obtained, and for the direction in which the gradation value is partial spread a main scanning direction, abbreviation, etc.

[Claim 6] The airline printer which drives this head and prints an image while it has the head which can form two or more kinds of dots which are characterized by providing the following, and from which magnitude differs and horizontal scanning and vertical scanning are performed A dot formation decision means to judge the formation existence of said dot based on the gradation value of the pixel which constitutes said image A decision result storage means to memorize this decision result A profile pixel extract means to extract the pixel which constitutes the profile about the configuration included in said image A high resolution-ized means to divide said pixel into two or more adjoining small pixels, and to define each gradation value of this small pixel based on predetermined relation, So that the dot of a profile dot decision means to determine the magnitude of the dot which forms said profile pixel in this profile pixel based on the gradation value of each smallness pixel divided and obtained, and the magnitude this determined as this profile pixel may be formed the decision result rewriting means which rewrites said memorized dot formation decision result, and the dot means forming which forms the dot of each of said magnitude based on this rewriting **** decision result

[Claim 7] It is an airline printer according to claim 6. The dot of the predetermined magnitude in the dot in which said formation is possible It is the dot which shifts a dot formation location in the predetermined direction, and is set up to other dots. Said profile dot decision means The airline printer which is a means to determine that the dot of said predetermined magnitude is formed to analyze the gradation value distribution of each smallness pixel which divided said profile pixel and was obtained, and for the direction in which the gradation value is partial spread said predetermined direction, abbreviation, etc.

[Claim 8] It is an airline printer according to claim 6. Said high resolution-ized means It is a means to divide said pixel into a main scanning direction. The dot of the predetermined magnitude in the dot in which said formation is possible It is the dot which shifts a dot formation location to a main scanning direction, and is set up to other dots. Said profile dot decision means The airline printer which is a means to determine that the dot of said predetermined magnitude is formed to analyze the gradation value distribution of each smallness pixel which divided said profile pixel and was obtained, and for the direction in which the gradation value is partial spread a main scanning direction, abbreviation, etc.

[Claim 9] It is the printing approach which drives this head and prints an image, having the head which can form two or more kinds of dots from which magnitude differs, and performing horizontal scanning and vertical scanning. Based on the gradation value of the pixel which constitutes said image, while judging the formation existence of said dot, this decision result is memorized. About the configuration included in said image, extract the pixel which constitutes the profile, and to the this extracted profile pixel, so that a small predetermined dot may be formed the printing approach which rewrites the decision result of said memorized dot formation existence, and forms the dot of each of said magnitude based on this rewriting **** decision result.

[Claim 10] It is the printing approach which drives this head and prints an image, having the head which can form two or more kinds of dots from which magnitude differs, and performing horizontal scanning and vertical scanning. Two or more pixels which adjoin among the pixels which constitute said image are summarized to a large pixel based on predetermined relation. By this large pixel, express said image and it is based on the gradation value of this large pixel. While judging the existence of the dot which should be formed in this large pixel, this decision result is memorized. The large pixel which constitutes the profile is extracted about the configuration included in said image. So that the dot of the magnitude which determined the magnitude of the dot which should be formed in this profile pixel based on the gradation value of two or more of said pixels summarized to this profile pixel, and was this determined as this profile pixel may be formed the printing approach which rewrites the decision result of said memorized dot formation

existence, and forms the dot of each of said magnitude based on this rewriting **** decision result.

[Claim 11] It is the printing approach which drives this head and prints an image, having the head which can form two or more kinds of dots from which magnitude differs, and performing horizontal scanning and vertical scanning. Based on the gradation value of the pixel which constitutes said image, while judging the formation existence of said dot, this decision result is memorized. The pixel which constitutes the profile is extracted about the configuration included in said image. Divide said pixel into two or more adjoining small pixels, and each gradation value of this small pixel is defined based on predetermined relation. So that the dot of the magnitude which determined the magnitude of the dot which forms said profile pixel in this profile pixel based on the gradation value of each smallness pixel divided and obtained, and was this determined as this profile pixel may be formed the printing approach which rewrites the decision result of said memorized dot formation existence, and forms the dot of each of said magnitude based on this rewriting **** decision result.

[Claim 12] It is used with the airline printer which forms two or more kinds of dots from which magnitude differs, and prints an image. The program which performs predetermined processing to the data of said image in order to judge the formation existence of each of this dot. The function to memorize this decision result while being the record medium recorded possible [reading] by computer and judging the formation existence of said dot based on the gradation value of the pixel which constitutes said image, The record medium which recorded the program which realizes the function to extract the pixel which constitutes the profile about the configuration included in said image, and the function which rewrites the decision result of said memorized dot formation existence so that a small predetermined dot may be formed in the this extracted profile pixel.

[Claim 13] It is used with the airline printer which forms two or more kinds of dots from which magnitude differs, and prints an image. The program which performs predetermined processing to the data of said image in order to judge the formation existence of each of this dot. The function which is the record medium recorded possible [reading] by computer, summarizes two or more pixels which adjoin among the pixels which constitute said image to a large pixel based on predetermined relation, and expresses said image by this large pixel. The function to memorize this decision result while judging the existence of the dot which should be formed in this large pixel based on the gradation value of this large pixel. The function to extract the large pixel which constitutes the profile about the configuration included in said image, So that the dot of the function to determine the magnitude of the dot which should be formed in this profile pixel, and the magnitude this determined as this profile pixel may be formed based on the gradation value of two or more of said pixels summarized to this profile pixel. The record medium which recorded the program which realizes the function which rewrites the decision result of said memorized dot formation existence.

[Claim 14] It is used with the airline printer which forms two or more kinds of dots from which magnitude differs, and prints an image. The program which performs predetermined processing to the data of said image in order to judge the formation existence of each of this dot. The function to memorize this decision result while being the record medium recorded possible [reading] by computer and judging the formation existence of said dot based on the gradation value of the pixel which constitutes said image, The function to extract the pixel which constitutes the profile about the configuration included in said image, The function to divide said pixel into two or more small pixels which adjoin mutually, and to define each gradation value of this small pixel based on predetermined relation, So that the dot of the function to determine the magnitude of the dot which forms said profile pixel in this profile pixel based on the gradation value of each smallness pixel divided and obtained, and the magnitude this determined as this profile pixel may be formed. The record medium which recorded the program which realizes the function which rewrites the decision result of said memorized dot formation existence.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to the technique which raises image quality by controlling formation of a dot by the profile part of the configuration included in an image in detail about the technique which forms a dot on a record medium and prints various kinds of images.

[0002]

[Description of the Prior Art] The airline printer which forms the dot of ink on a record medium and prints an image as an output unit of various images outputted from a computer, such as a natural image, and an alphabetic character, a graphic form, is used widely. Such an airline printer is printing various kinds of images by dividing an image into a fine pixel and forming a dot on a record medium according to the gradation value of each pixel. That is, in the dark part (part with the high gradation value of a pixel) of a printing image, according to each gradation value, the formation existence of a dot is judged for every pixel, and a dot is formed in each pixel location by the bright part (part with a low gradation value) of a printing image, so that a dot may be hard to be formed, so that a dot may be easy to be formed. In this way, if the printed dot is seen as the whole image, the light and darkness of an image will change according to the roughness and fineness of the dot currently formed, and the image which has a broad gradation value will be printed.

[0003] In the dark part of a printing image, it is high-density, and as a result of being controlled so that a dot is formed, a dot is formed in almost all the pixel location on a record medium. Since the problem of the so-called banding that a clearance will be generated in the shape of a muscle in the part of the boundary line of a pixel, and image quality will deteriorate at this time if the magnitude of the dot formed is small arises, the magnitude of the dot formed on a record medium is set up so that it may usually become larger than pixel spacing on a record medium.

[0004] Moreover, the airline printer which controls positively the magnitude of the dot formed on a record medium by recently is also developed. When not controlling magnitude of a dot, only two conditions of whether the dot is formed cannot be expressed in each pixel, but if the magnitude of a dot is controlled, it becomes possible to express the condition of many in one pixel, consequently a rich gradation expression can be realized. That is, if a big dot is formed in a pixel with a high gradation value and a small dot is formed in a pixel with a low gradation value, compared with the case where the roughness and fineness of a dot only express gradation, the degree of freedom of a gradation expression can be extended and it will become possible to print more the natural image which has a broad gradation value by high definition.

[0005]

[Problem(s) to be Solved by the Invention] However, when images, such as a graphic form and an alphabetic character, were printed using these airline printers, the actual twist also had the problem that profiles, such as a graphic form and an alphabetic character, may be printed thickly. That is, since a graphic form, an alphabetic character, etc. are usually black and it is expressed, it is formed by the dot with it, and since the big dot is set up more greatly than a pixel, the printed profile will become actually thicker. [a high therefore gradation value and] [big] But if

the magnitude of a dot is set up more smallish, the new problem of becoming easy to generate banding will arise.

[0006] Furthermore, when images, such as a graphic form and an alphabetic character, were printed using these airline printers, the graphic form or alphabetic character of a smooth profile were not obtained, but there was also a problem that image quality may deteriorate. Namely, since the dot is formed in each pixel location obtained by subdividing an image as mentioned above, unless a profile is in agreement with the direction where a pixel is located in a line, the polygonal line must approximate and express and, for this reason, a smooth profile may not be obtained. Of course, if an image is divided more finely and a pixel is made small, it is possible to smooth a profile, but the problem that the time amount which printing of an image takes increases arises as the number of pixels which constitutes an image increases.

[0007] This invention is made in order to solve the above-mentioned technical problem in the conventional technique, and it aims at offering the technique which raises the printing image quality of the image containing a graphic form, an alphabetic character, etc.

[0008]

[The means for solving a technical problem, and its operation and effectiveness] The next configuration was used for the 1st airline printer of this invention in order to solve a part of above-mentioned technical problem [at least]. Namely, the 1st airline printer of this invention is equipped with the head which can form two or more kinds of dots from which magnitude differs. A dot formation decision means to be the airline printer which drives this head and prints an image, performing horizontal scanning and vertical scanning, and to judge the formation existence of said dot based on the gradation value of the pixel which constitutes said image. So that a small predetermined dot may be formed by a decision result storage means to memorize this decision result, a profile pixel extract means to extract the pixel which constitutes the profile about the configuration included in said image, and this profile pixel let it be a summary to have the decision result rewriting means which rewrites said memorized dot formation decision result, and the dot means forming which forms the dot of each of said magnitude based on this rewriting **** decision result.

[0009] Moreover, the 1st printing approach of this invention corresponding to the above-

mentioned airline printer it is the printing approach which drives this head and prints an image, having the head which can form two or more kinds of dots from which magnitude differs, and performing horizontal scanning and vertical scanning. Based on the gradation value of the pixel which constitutes said image, while judging the formation existence of said dot, this decision result is memorized. About the configuration included in said image, extract the pixel which constitutes the profile, and to the this extracted profile pixel, so that a small predetermined dot may be formed the decision result of said memorized dot formation existence is rewritten, and let it be a summary to form the dot of each of said magnitude based on this rewriting **** decision result.

[0010] While judging the dot which should be formed in each pixel in this the 1st airline printer and printing approach based on the gradation value of the pixel which constitutes the image, about the configuration expressed in the image, the pixel which constitutes the profile is extracted, and a decision result is changed into the extracted pixel so that a small predetermined dot may be formed. In this way, if a dot is formed on a record medium based on the decision result of the dot formation for which it opted, since the profile part of a configuration is printed by the small dot, it can be lost that a profile is printed of it actually more thickly, and it can raise printing image quality.

[0011] Thus, although a profile part is transposed to a small dot and printed, the interior of a configuration is printed using the dot of the usual magnitude, therefore --- for example, since the interior, such as an alphabetic character, uses a big dot and is printed also when printing a black alphabetic character, a black graphic form, etc., distinctly, it is black, and it will be printed and the deep problem of becoming easy to generate banding also in solid fields, such as the so-called graphic form, does not produce a line.

[0012] The gradation value of each pixel which constitutes this group is compared with a predetermined threshold by making into a group two or more pixels which adjoin a main scanning

direction, and you may make it extract a profile pixel from this comparison result in this 1st airline printer based on predetermined relation. By extracting a profile pixel using such an approach, it becomes possible to raise the quality of a printing image.

[0013] The next configuration was used for the 2nd airline printer of this invention in order to solve a part of above-mentioned technical problem [at least]. Namely, the 2nd airline printer of this invention is equipped with the head which can form two or more kinds of dots from which magnitude differs. It is the airline printer which drives this head and prints an image while performing horizontal scanning and vertical scanning. A low resolution-sized means to summarize two or more pixels which adjoin among the pixels which constitute said image to a large pixel based on predetermined relation, and to express said image by this large pixel. A dot formation decision means to judge the existence of the dot which should be formed in this large pixel based on the gradation value of this large pixel. A decision result storage means to memorize this decision result, and a profile pixel extract means to extract the large pixel which constitutes the profile about the configuration included in said image. So that the dot of a profile dot decision means to determine the magnitude of the dot which should be formed in this profile pixel, and the magnitude this determined as this profile pixel may be formed based on the gradation value of two or more of said pixels summarized to this profile pixel let it be a summary to have said decision result rewriting means which rewrites the decision result of the memorized dot formation, and the dot means forming which forms the dot of each of said magnitude based on this rewriting **** decision result.

[0014] Moreover, the 2nd printing approach of this invention corresponding to the above-mentioned airline printer It is the printing approach which drives this head and prints an image, having the head which can form two or more kinds of dots from which magnitude differs, and performing horizontal scanning and vertical scanning. Two or more pixels which adjoin among the pixels which constitute said image are summarized to a large pixel based on predetermined relation. By this large pixel, express said image and it is based on the gradation value of this large pixel. While judging the existence of the dot which should be formed in this large pixel, this decision result is memorized. The large pixel which constitutes the profile is extracted about the configuration included in said image. So that the dot of the magnitude which determined the magnitude of the dot which should be formed in this profile pixel based on the gradation value of two or more of said pixels summarized to this profile pixel, and was this determined as this profile pixel may be formed the decision result of said memorized dot formation existence is rewritten, and let it be a summary to form the dot of each of said magnitude based on this rewriting **** decision result.

[0015] In this the 2nd airline printer and printing approach, two or more pixels which adjoin among the pixels which constitute the image are summarized to one large pixel based on predetermined relation, and a large pixel expresses said image. Subsequently, while judging the dot which should be formed in each large pixel based on the gradation value of each ****, the large pixel which constitutes the profile of a configuration out of an image is extracted. About the extracted large pixel, the magnitude of the dot which should be formed based on the gradation value of two or more pixels which constitute this large pixel is determined, and the decision result of a dot is changed so that the dot of the this determined magnitude may be formed. In this way, if a dot is formed on a record medium based on the decision result of the dot formation for which it opted, since a profile part is printed by the dot in which the two or more pixels information summarized to the large pixel was reflected, a profile can become smooth and it can raise printing image quality.

[0016] Moreover, the magnitude of the dot of the large pixel which constitutes a profile is only changed into suitable magnitude, and the number of the dots which printing of an image takes is not made to increase in this the 2nd airline printer and printing approach. Therefore, although printing by high definition is possible, the time amount which printing takes does not increase. [0017] In the 2nd airline printer and printing approach, it is also suitable to perform it as follows. About the dot of predetermined magnitude, the formation location of a dot is shifted and set up in the predetermined direction in the dot of the various magnitude which can form this airline printer. It faces determining the magnitude of the dot which should be formed in a profile pixel,

and the gradation value distribution of two or more pixels which constitute this profile pixel is analyzed, and when the direction in which the gradation value is partial is carrying out abbreviation coincidence with said predetermined direction, it determines to form the dot of said predetermined magnitude. If it does in this way, since the dot which constitutes the profile of a printing image can be formed in a more desirable location, a profile can become smooth and printing image quality can be raised. Moreover, since the number of the dots which have only changed into the more suitable dot the dot which constitutes a profile, and printing takes it also in this airline printer and the printing approach is not made to increase, although printing by high definition is possible, the time amount which printing takes does not increase.

[0018] Moreover, in the 2nd airline printer and printing approach, the formation location of a dot may be shifted and set as a main scanning direction about the dot of predetermined magnitude in two or more pixels which constitute a profile pixel inclines toward the dot of predetermined magnitude of the dot of the various magnitude which can be formed. When the gradation value distribution of two or more pixels which constitute a profile pixel inclines toward the main scanning direction, it determines to form the dot of predetermined magnitude in this profile pixel. Since the dot which constitutes the profile of a printing image by carrying out like this can be formed in a more desirable location, the printing image of a smooth profile can be obtained.

[0019] The next configuration was used for the 3rd airline printer of this invention in order to solve a part of above-mentioned technical problem [at least]. Namely, the 3rd airline printer of this invention is equipped with the head which can form two or more kinds of dots from which magnitude differs. A dot formation decision means to be the airline printer which drives this head and prints an image, performing horizontal scanning and vertical scanning, and to judge the formation existence of said dot based on the gradation value of the pixel which constitutes said image. A decision result storage means to memorize this decision result, and a profile pixel extract means to extract the pixel which constitutes the profile about the configuration included in said image. A high resolution-sized means to divide said pixel into two or more adjoining small pixels, and to define each gradation value of this small pixel based on predetermined relation. So that the dot of a profile dot decision means to determine the magnitude of the dot which forms said profile pixel in this profile pixel based on the gradation value of each smallness pixel divided and obtained, and the magnitude this determined as this profile pixel may be formed let it be a summary to have the decision result rewriting means which rewrites said memorized dot formation decision result, and the dot means forming which forms the dot of each of said magnitude based on this rewriting **** decision result.

[0020] Moreover, the 3rd printing approach of this invention corresponding to the above-mentioned airline printer It is the printing approach which drives this head and prints an image, having the head which can form two or more kinds of dots from which magnitude differs, and performing horizontal scanning and vertical scanning. Based on the gradation value of the pixel which constitutes said image, while judging the formation existence of said dot, this decision result is memorized. The pixel which constitutes the profile is extracted about the configuration included in said image. Divide said pixel into two or more adjoining small pixels, and each gradation value of this small pixel is defined based on predetermined relation. So that the dot of the magnitude which determined the magnitude of the dot which forms said profile pixel in this profile pixel based on the gradation value of each smallness pixel divided and obtained, and was this determined as this profile pixel may be formed the decision result of said memorized dot formation existence is rewritten, and let it be a summary to form the dot of each of said magnitude based on this rewriting **** decision result.

[0021] In this the 3rd airline printer and printing approach, while judging the dot which should be formed in each pixel based on the gradation value of the pixel which constitutes an image, the pixel which constitutes the profile is extracted about the configuration expressed in the image. Subsequently, the extracted pixel is divided into two or more adjoining small pixels, and the gradation value of each smallness pixel is defined based on predetermined relation. In this way, based on the gradation value of each smallness pixel for which it asked, the magnitude of the dot which should be formed in this profile pixel is determined, and the decision result of a dot is changed so that the dot of the this determined magnitude may be formed. In this way, if a dot is formed on a record medium based on the decision result of the dot formation for which it opted,

since a profile part is printed by the dot in which the information on each smallness pixel was reflected, a profile can become smooth and it can raise printing image quality.

[0022] Moreover, the magnitude of the dot of the pixel which constitutes a profile is only changed, and the number of the dots which printing of an image takes is not made to increase in this the 3rd airline printer and printing approach. Therefore, although printing by high definition is possible, the time amount which printing takes does not increase.

[0023] In the 3rd airline printer and printing approach, the formation location of a dot may be shifted in the predetermined direction about the dot of predetermined magnitude in the dot of the various magnitude which can be formed. It faces determining the magnitude of the dot of a profile pixel, and the gradation value distribution of two or more small pixels into which this profile pixel was divided is analyzed, and when the direction in which the gradation value is partial is carrying out abbreviation coincidence with said predetermined direction, it determines to form the dot of said predetermined magnitude. If it carries out like this, since the dot of a profile part can be formed in the location for which were more suitable, a profile can become smooth and printing image quality can be raised. Moreover, in this airline printer and the printing approach, since the number of the dots which printing of an image takes is not made to increase, although printing by high definition is possible, the time amount which printing takes does not increase.

[0024] Moreover, in the 3rd airline printer and printing approach, the formation location of a dot may be shifted to a main scanning direction about the dot of predetermined magnitude. When the gradation value distribution of two or more small pixels into which the profile pixel was divided inclines toward the main scanning direction, it determines to form the dot of the magnitude which shifted the location. If it carries out like this, since the dot which constitutes the profile of a printing image can be formed in a more desirable location, the printing image of a smooth profile can be obtained.

[0025] In the airline printer equipped with two or more kinds from which magnitude differs of the heads which can form a dot and computers, it realizes also by making various control perform to this computer, and deals in the 1st [of a more than] thru/ or 3rd printing approach, and the printing approach. Therefore, the mode as a record medium which memorized the program which realizes various above-mentioned functions possible [reading] by computer is also contained in this invention. Namely, the 1st record medium corresponding to the 1st airline printer and printing approach of this invention It is used with the airline printer which forms two or more kinds of dots from which magnitude differs, and prints an image. The program which performs predetermined processing to the data of said image in order to judge the formation existence of each of this dot The function to memorize this decision result while being the record medium recorded possible [reading] by computer and judging the formation existence of said dot based on the gradation value of the pixel which constitutes said image, Let it be a summary to have recorded the program which realizes the function to extract the pixel which constitutes the profile about the configuration included in said image, and the function which rewrites the decision result of said memorized dot formation existence so that a small predetermined dot may be formed in the this extracted profile pixel.

[0026] Moreover, the 2nd record medium corresponding to the 2nd airline printer and printing approach of this invention It is used with the airline printer which forms two or more kinds of dots from which magnitude differs, and prints an image. The program which performs predetermined processing to the data of said image in order to judge the formation existence of each of this dot The function which is the record medium recorded possible [reading] by computer, summarizes two or more pixels which adjoin among the pixels which constitute said image to a large pixel based on predetermined relation, and expresses said image by this large pixel. The function to memorize this decision result while judging the existence of the dot which should be formed in this large pixel based on the gradation value of this large pixel. The function to extract the large pixel which constitutes the profile about the configuration included in said image. So that the dot of the function to determine the magnitude of the dot which should be formed in this profile pixel, and the magnitude this determined as this profile pixel may be formed based on the gradation value of two or more of said pixels summarized to this profile pixel Let it be a summary to have recorded the program which realizes the function which rewrites the

decision result of said memorized dot formation existence.

[0027] Moreover, the 3rd record medium corresponding to the 3rd airline printer and printing approach of this invention It is used with the airline printer which forms two or more kinds of dots from which magnitude differs, and prints an image. The program which performs predetermined processing to the data of said image in order to judge the formation existence of each of this dot The function to memorize this decision result while being the record medium recorded possible [reading] by computer and judging the formation existence of said dot based on the gradation value of the pixel which constitutes said image. The function to extract the pixel which constitutes the profile about the configuration included in said image. The function to divide said pixel into two or more small pixels which adjoin mutually, and to define each gradation value of this small pixel based on predetermined relation. So that the dot of the function to determine the magnitude of the dot which forms said profile pixel in this profile pixel based on the gradation value of each smallness pixel divided and obtained, and the magnitude this determined as this profile pixel may be formed Let it be a summary to have recorded the program which realizes the function which rewrites the decision result of said memorized dot formation existence.

[0028] The program recorded on this the 1st thru/ or 3rd record medium is read into a computer, and when this computer controls an airline printer, the image quality of the profile section of a printing image can be improved.

[0029] [Embodiment of the Invention] A. Explain the gestalt of operation of configuration this invention of equipment based on an example. Drawing 1 is the explanatory view showing the configuration of the airline printer used in the example of this invention. The color scanner 21 and the color printer 20 are connected to the computer 80, and this airline printer functions as an airline printer as a whole by loading a predetermined program to a computer 80 and performing so that it may illustrate. After the color copy which it is going to print is changed into the color picture data ORG which can recognize a computer 80 with a color scanner 21, it is inputted into a computer 80. A computer 80 performs a predetermined image processing, changes the color picture data ORG into the image data which can be printed by the printer, and outputs them to a color printer 20. The image created with various kinds of application programs 91 in the computer 80 top other than the image captured with the color scanner 21, the image which added processing to the image captured from the color scanner 21 are used for the image data which a computer 80 treats. The conversion result of these image data is outputted to a color printer 20 as image data FNL which can be printed by the printer, and a color printer 20 forms the ink dot of each color on a print sheet according to this image data FNL. Consequently, the color picture corresponding to the color picture data outputted from the computer 80 will be obtained on a print sheet.

[0030] ROM82, CPU81 and RAM83, input interface 84, and the output interface with which a computer 80 performs various kinds of data processing --- it consists of 85, CRT controller (CRTC) 86, disk controller (DDC) 87, and serial input/output interface (SIO) 88 grade, and it connects by bus 89 and an exchange of data is possible for these to mutual. CRTC86 controls the signal output to CRT23 in which color display is possible, and DDC87 controls an exchange of data with a flexible disk drive 25, a hard disk 26 or the CD-ROM drive which is not illustrated, etc. Various kinds of programs which are loaded to RAM83 and performed by CPU81, and various kinds of programs offered in the form of a device driver are memorized by ROM82 and the hard disk 26. Moreover, if SIO88 is connected to a dial-up line PNT via a modem 24, it will become possible from the server SV on an external network to download required data and a required program to a hard disk 26.

[0031] If a power source is supplied to a computer 80, the operating system memorized by ROM82 and the hard disk 26 will start, and the various application programs 91 will run by the bottom of management of an operating system.

[0032] A color printer 20 is a printer which can print a color picture, and is using the ink jet printer which prints a color picture in this example by carrying out the regurgitation of the ink of a total of four colors of cyanogen Magenta Hierro Black on a print sheet. Of course, you may be

the color printer which uses the ink of a total of six colors which added the ink of a light cyanogen light Magenta other than these 4 color ink. However, this invention may be a color printer which is not limited to the color printer which breathes out ink and forms a dot, and forms a dot by the hot printing method of a sublimated type ***** melting mold. Moreover, although the method using piezo-electric element PE is used for the ink regurgitation method of the ink jet printer used by this example so that it may mention later, it is good also as a thing using the printer equipped with the head which carries out the regurgitation of the ink with other methods. For example, it is good also as what applies ink to the printer of the method which carries out the regurgitation with the bubble (bubble) which energizes at the heater arranged to the ink path, and is generated in an ink path.

[0033] Moreover, the color printer 20 of this example is a printer which can form three kinds of dots of the size, the inside, and smallness from which a variable dot impact printer, i.e., magnitude, differs for every color. A variable dot impact printer is used, and if the magnitude of the dot to form is changed, since it will become possible to express the gradation of a multiple value for every dot, the image of a rich gradation expression can be printed. In addition, the color printer 20 of this example forms the dot of three kinds of magnitude by devising the regurgitation approach of ink using a single ink regurgitation nozzle. About the regurgitation approach of this ink, it mentions later. Moreover, a passage clear from explanation of the ink regurgitation approach, the magnitude of a dot is not restricted to three kinds and may form the dot of varieties further if needed.

[0034] Drawing 2 is the block diagram showing the configuration of the software of this airline printer notionally. In a computer 80, all the application programs 91 operate under an operating system. The image data which the video driver 90 and the printer driver 92 are included in the operating system, and is outputted to it from each application program 91 is outputted to a color printer 20 through these drivers. The application programs 91, such as a retouch which processes an image, display on CRT23 the image captured from the color scanner 21 through a video driver 90, and they can perform predetermined processing, checking an image.

[0035] If an application program 91 emits a printing instruction, the printer driver 92 of a computer 80 will receive image data from an application program 91, will perform a predetermined image processing, and will change it into the image data which a printer can print. The image processing of the resolution conversion module 93, the color conversion module 94, the multiple-value-sized module 95, and the interface module 96 which a printer driver 92 performs as notionally shown in drawing 2 is large, and consists of four modules. Although the content of the image processing performed by each module is mentioned later, after the image data which the printer driver 92 received is changed by these modules, it is outputted to a color printer 20 as final image data FNL. In addition, although it is only playing the role which forms a dot according to image data FNL and the color printer 20 of this example is not performing the image processing, of course, it may perform a part of image transformation by the color printer 20.

[0036] The outline configuration of the color printer 20 of this example is shown in drawing 3. This color printer 20 consists of the device in which drive the print head 41 carried in carriage 40, and the regurgitation of ink and dot formation are performed, a device in which this carriage 40 is made to reciprocate to the shaft orientations of a platen 36 by the carriage motor 30, a device in which a print sheet P is conveyed by the paper feed motor 35, and a control circuit 60 so that it may illustrate. The device in which the shaft orientations of a platen 36 are made to reciprocate consists of location detection sensor 34 grades which detect the sliding shaft 33 held possible [sliding of the carriage 40 with which carriage 40 was constructed in parallel with the shaft of a platen 36], the pulley 32 which stretches the endless driving belt 31 between the carriage motors 30, and the home position of carriage 40. The device in which a print sheet P is conveyed consists of the platen 36, a paper feed motor 35 made to rotate a platen 36, a feed auxiliary roller which is not illustrated, and a gear train (graphic display abbreviation) which tells a revolution of the paper feed motor 35 to a platen 36 and a feed auxiliary roller. The control circuit 60 is controlling appropriately the motion of the paper feed motor 35, the carriage motor 30, and a print head 41, exchanging the control panel 59 and signal of a printer. The print sheet P

supplied to the color printer 20 is set so that it may be put between a platen 36 and a feed auxiliary roller, and only the specified quantity is sent according to angle of rotation of a platen 36.

[0037] the ink cartridge 42 which contains black (K) ink on carriage 40, and (Cyanogen C) Magenta (M) Hierro -- it is equipped with the ink cartridge 43 which contains the ink of (Y). Of course, you may carry out making the same ink cartridge contain K ink and Y ink etc. The receipt to one cartridge being possible, then an ink cartridge can be constituted for two or more ink in a compact. The head 44-45-46-47 for ink regurgitation is formed in the print head 41 in the lower part of carriage 40 to each ink of K-C-M-Y, respectively. If introductory tubing which is not illustrated is set up by the pars basilaris ossis occipitalis of carriage 40 for every ink and carriage 40 is equipped with an ink cartridge, each ink in a cartridge will be supplied to each head 44 for ink regurgitation thru/or 47 through introductory tubing. By the approach explained below, the ink supplied to each head is breathed out from a print head 41, and forms a dot on a print sheet. [0038] Drawing 4 (a) is the explanatory view having shown the internal structure of each color head. 48 nozzles Nz are formed in the head 44 for ink regurgitation of each color thru/or 47 for every color, and piezo-electric element PE is prepared on the ink path 50 and its path at each nozzle. The crystal structures of piezo-electric element PE are distortion and the component which changes electric-mechanical energy into a high speed extremely by impression of an electrical potential difference as everyone knows. As shown in drawing 4 (b), piezo-electric element PE elongates only the impression time amount of an electrical potential difference, and one side attachment wall of the ink path 50 is made to deform in this example by carrying out the seal of approval of the electrical potential difference of predetermined time width of face to inter-electrode [which was prepared in the ends of piezo-electric element PE]. Consequently, it expands and contracts according to extension of piezo-electric element PE, the ink equivalent to a part for this contraction serves as Particle lp, and the volume of the ink path 50 is breathed out at high speed from Nozzle Nz. By sinking into the print sheet P with which the platen 36 was equipped with this ink lp, a dot is formed on a print sheet P.

[0039] Drawing 5 is the explanatory view showing the array of the head 44 for ink regurgitation of thru/or the ink jet nozzle Nz in 47. 6 sets of nozzle arrays which carry out the regurgitation of the ink for every color are formed in the base of the head for ink regurgitation, and 48 nozzles Nz per 1 set of nozzle arrays are alternately arranged in the fixed nozzle pitch k so that it may illustrate. In addition, 48 nozzles Nz contained in each nozzle array do not need to be arranged alternately, and may be arranged on the straight line. However, if it arranges alternately as shown in drawing 5 (a), there is an advantage of being easy to set up the nozzle pitch k small on manufacture.

[0040] As shown in drawing 5, as for the head 44 for ink regurgitation of each color thru/or 47, the location of a head has shifted in the conveyance direction of carriage 40. Moreover, the location has shifted in the conveyance direction of carriage 40 also about the nozzle for every color head on the relation by which the nozzle is arranged alternately. The control circuit 60 of a color printer 20 is driving each head to the suitable timing, taking into consideration the difference in the head actuation timing by the difference in the location of a nozzle, in case a nozzle is driven conveying carriage 40.

[0041] Although the color printer 20 of this example is equipped with the nozzle Nz of the diameter of fixed as shown in drawing 5, it can form three kinds of dots from which magnitude differs mutually using this nozzle Nz. This principle is explained below. Drawing 6 is the explanatory view having shown the relation between the actuation wave of the nozzle Nz at the time of ink being breathed out, and the ink lp breathed out. It is a wave at the time of the actuation wave shown with the broken line in drawing 6 carrying out the regurgitation of the usual dot. Once it impresses an electrical potential difference lower than reference voltage to piezo-electric element PE in the section d2, with drawing 4 having explained previously, piezo-electric element PE will deform the cross section of the ink path 50 into reverse in the increasing direction. The ink interface Me will be in the condition of having cratered inside Nozzle Nz as the amount of supply of ink ran short to amplification of the ink path 50 and it was shown in the condition A of drawing 6, since there was a limitation in the speed of supply of the ink to

a nozzle. Moreover, if an electrical potential difference is rapidly made low as shown at the section d1 using the actuation wave shown as the continuous line of drawing 6, the amount of supply of ink is further insufficient, and it will be in the condition of having cratered inside greatly compared with Condition A as shown in the Condition a.

[0042] Next, if a high electrical potential difference is impressed to piezo-electric element PE (section d3), the ink in a path will be compressed by reduction of the cross section of the ink path 50, and an ink droplet will be breathed out from an ink nozzle. At this time, the ink droplet which will be breathed out if the ink amount of supply is insufficient also becomes small. Therefore, from the condition (Condition A) of having seldom cratered the ink interface inside, as shown in Condition B and Condition C, a big ink droplet is breathed out, and from the condition (Condition a) in which the ink interface was cratered greatly, as shown in Condition b and Condition c, a small ink droplet is breathed out. Thus, if the rate of change at the time (sections d1 and d2) of making driver voltage low is changed, the magnitude of the dot formed can be changed.

[0043] A color printer 20 outputs two kinds of actuation waves continuously. This situation was shown in drawing 7. If the rate of change at the time of making an electrical potential difference low is compared, it turns out that actuation wave W1 and W2 deal with the respectively small ink droplet lps and the big ink droplet lpm. While carriage 40 moves to a main scanning direction, the case where output actuation wave W1 and actuation wave W2 are subsequently outputted is considered. The small ink droplet lps breathed out by actuation wave W1 has a comparatively small flight rate, and the direction of the ink droplet lps with the small [a duration since it is large, after being breathed out until it reaches a print sheet] flight rate big ink droplet lpm breathed out by actuation wave W2 becomes long. Naturally, a travel also becomes longer than the ink droplet lpm with the small, bigger ink droplet lps to the main scanning direction of the location which reached the print sheet from the regurgitation location of ink. Therefore, if the timing of actuation wave W1 and actuation wave W2 is adjusted, as shown in drawing 7, it will become possible to carry out the regurgitation of the small ink droplet lps and the big ink droplet lpm to the same pixel. In addition, in the color printer 20 of this example, as shown in drawing 7, when it forms in the same pixel, the timing between two actuation waves (W1, W2) is set up so that the formation location of a small dot and an inside dot may shift to a main scanning direction slightly.

[0044] By supplying only actuation wave W1 to piezo-electric element PE, by supplying only actuation wave W2 for a small dot to piezo-electric element PE, both actuation wave W1 and W2 are supplied for an inside dot, and the large dot is formed in the color printer 20 of this example by carrying out the regurgitation of the two ink droplets to the same pixel. Of course, it is also possible by increasing the class of actuation wave to form the dot of the magnitude of varieties further.

[0045] Drawing 8 is the explanatory view showing the internal configuration of the control circuit 60 of a color printer 20. PC interface 64 and the paper feed motor 35 and carriage motor 30 grade which exchange data with CPU61, PROM62, RAM63, and a computer 80, and peripheral-device I/O section (PIO) 65, timer 66 and the actuation buffer 67 grade which perform an exchange of data are prepared in the interior of a control circuit 60 so that it may illustrate. The actuation buffer 67 is used as a buffer which supplies the on-off signal of a dot to the head 44 for ink regurgitation thru/or 47. It connects by bus 68 mutually and these can be mutually exchanged to data. Moreover, the oscillator 70 which outputs an actuation wave with predetermined frequency, and the distribution output machine 69 which distributes the output from an oscillator 70 to predetermined timing the head 44 for ink regurgitation thru/or 47 are also formed in the control circuit 60.

[0046] The control circuit 60 which has the configuration shown in drawing 8 will store the on-off signal of a dot in RAM63 temporarily, if image data FNL is received from a computer 80.

CPU61 outputs dot data to the actuation buffer 67 to predetermined timing, taking a motion and synchronization of the paper feed motor 35 or the carriage motor 30.

[0047] Next, when CPU61 outputs the on-off signal of a dot to the actuation buffer 67 explains the mechanism by which a dot is breathed out. Drawing 9 is the explanatory view in which taking

the head 44 for ink regurgitation thru/or one nozzle train of 47 for an example, and showing the connection. It is infixed in the circuit which the head 44 for ink regurgitation thru/or the nozzle train of 47 make the actuation buffer 67 a source side, and makes the distribution output machine 69 a sink side, and one side of the electrode bundles up to each output terminal of the actuation buffer 67, and, as for each piezo-electric element PE which constitutes a nozzle train, another side is connected to it for it at the output terminal of the distribution output machine 69, respectively. From the distribution output machine 69, the actuation wave of an oscillator 70 is outputted as shown in drawing 9. If CPU41 outputs the on-off signal of the dot for every nozzle to the actuation buffer 67, only piezo-electric element PE which received the ON signal will drive by the actuation wave. Consequently, the ink particles lp are breathed out all at once from the nozzle of piezo-electric element PE which had received the ON signal from the actuation buffer 67.

[0048] The color printer 20 which has the above hardware configurations moves a print sheet P in the direction of vertical scanning by driving the carriage motor 30 by moving the head 44 for ink regurgitation of each color thru/or 47 to a main scanning direction to a print sheet P, and driving the paper feed motor 35. The color printer 20 is printing the color picture on a print sheet by driving a print head 41 to suitable timing under control of a control circuit 60, repeating horizontal scanning and vertical scanning of carriage 40.

[0049] B. the outline of an image processing -- as mentioned above, a computer 80 performs a predetermined image processing at a color picture, and a color printer 20 generates image data FNL, although it has the function which prints a color picture in response to supply of image data FNL. Drawing 10 is a flow chart which shows the outline of the image processing which CPU81 performs within the printer driver 92 of a computer 80. Hereafter, the outline of an image processing is explained according to this drawing.

[0050] If an image processing is started, CPU81 will input image data (step S100). This image data is data supplied from an application program 91, as drawing 2 explained, and it is data which constitute an image and which have 256 gradation of the value of 0-255 about the color of each R-G-B for every pixel. The resolution of this image data changes according to the resolution of the data ORG of a subject-copy image etc.

[0051] CPU81 is changed into resolution for a color printer 20 to print the resolution of the inputted image data (step S102). When the resolution of image data is lower than print resolution, resolution conversion is performed by generating new data between the subject-copy image data which adjoin by linear interpolation. Conversely, when the resolution of image data is higher than print resolution, resolution conversion is performed by thinning out data at a fixed rate.

[0052] Next, CPU81 performs color transform processing (step S104). Color transform processing is processing which changes the image data which consists of a gradation value of R-G-B into the data of the gradation value of each color of the C**M**Y grade used by the color printer 20. This processing is performed using color translation table LUT (refer to drawing 2), and the combination of C-M-Y-K for expressing the color which consists of each combination of R-G-B by the color printer 20 is memorized by LUT. About the processing itself which performs color conversion using a color translation table, well-known various techniques can be applied, for example, processing by the interpolation operation can be applied.

[0053] Termination of color transform processing starts multiple-value-sized processing (step S106). In this example, the image data after color conversion serves as 256 gradation images of four colors of C-M-Y-K. On the other hand, in the color printer 20 of this example, only a total of four conditions, "a large dot is formed", cannot be taken. ["a dot is not formed", "a small dot being formed", "an inside dot being formed", and] Therefore, it is necessary to change the image which has 256 gradation into the image expressed with 4 gradation which a color printer 20 can express. The processing which performs such conversion is multiple-value-sized processing. That is, 256 gradation of a subject-copy image is expressed with 4 gradation value which can express a color printer 20 by forming each dot of size, inside, and smallness on a record medium, and changing easy according to the gradation value of a subject-copy image. Drawing 11 is the explanatory view showing signs that the rate of dot record of each dot of size, inside, and smallness changes, according to the gradation value of a subject-copy image. In case the rate of

dot record prints the solid field of a certain gradation value, it means the rate that a dot is formed to the pixel in this field. Actually, like drawing 11, the table (rate table of dot record) which recorded the rate of dot record to a gradation value for every dot of each magnitude is memorized by RAM83 of a computer 80, and to the gradation value of a subject-copy image, multiple-value-ized processing is performed to it so that a dot may be formed at a rate memorized by the rate table of dot record. Moreover, the color printer 20 of this example extracts the profile of the configuration included in an image in multiple-value-ized processing, also combines the special processing for raising the image quality of a printing image, and is performed so that it may mention later.

[0054] CPU81 starts interface processing, after ending multiple-value-ized processing (step S108). This processing is processing which rearranges the image data changed into the format that multiple-value-ized processing expresses the formation existence of a dot into the sequence which should be transmitted to a color printer 20. That is, as mentioned above, repeating horizontal scanning and vertical scanning of carriage 40, a color printer 20 drives a print head 41, and forms the dot train (raster) on the print sheet P. Since two or more nozzles Nz are formed in the head 44 for ink regurgitation for every color thru/or 47 as explained using drawing 4, two or more rasters can be formed by one horizontal scanning. It is mutually separated only from the nozzle pitch k of these rasters. Although considering as the smallest possible value is desirable as for the nozzle pitch k, it is difficult to make the nozzle pitch k small to spacing (considerable, when the nozzle pitch k is 1) of a pixel on account of head manufacture. Consequently, in order to form the raster located in a line at intervals of a pixel, two or more rasters which left only the nozzle pitch k are formed first, then a little head location is shifted, and control of forming a new raster between rasters is needed.

[0055] Moreover, in order to divide one raster into horizontal scanning of multiple times, to form it, in order to raise printing image quality, or to shorten printing time amount further, control of forming a dot by each at the time of *** of horizontal scanning and double action is also performed. If these control is performed, since the sequence that a color printer 20 forms a dot actually will turn into different sequence from the sequence of a pixel on image data, image data is rearranged in interface processing.

[0056] Termination of interface processing outputs image data to a color printer 20 as image data FNL which a printer can print (step S110).

[0057] C. By the color printer 20 of this example, although the outline of the multiple-value-ized processing multiple-value-ized processing in this example was already explained, in order to raise the image quality of a printing image, combine the processing explained below in multiple-value-ized processing, and perform it. Although the content of the processing explained below is summarizable in it being extracting the profile contained in the image and forming a small dot in the pixel of a profile part, it can use various approaches properly according to the situation which is going to print an image. But there is the approach of transposing the dot in which a profile pixel is formed to an only small dot as a simple approach. Although at least this can raise printing image quality but, drawing also has a method of using the information on resolution higher than the image resolution at the time of printing in improvement in the further image quality. There is the approach of incorporating from the outside by making information on high resolution into image data also in this approach, if it sees in detail, and there is the approach of making it generate inside, performing multiple-value-ized processing. Below, these three approaches are explained in order.

[0058] (1) Multiple-value-ized processing of the 1st multiple-value-ized processing 1st is processing equivalent to the approach previously broken as simplest approach. The flow chart which shows the flow of the 1st multiple-value-ized processing is shown in drawing 12. The 1st multiple-value-ized processing consists of three steps greatly so that it may illustrate. The profile pixel extract processing (step S200) performed first receives the gradation image data after color transform processing (refer to drawing 10), and extracts the profile contained in an image. Although various approaches are applicable to the extract approach of a profile, Ushiro explains this collectively.

[0059] An extract of a profile pixel performs half toning processing (step S202). Half toning

processing is processing which makes the nucleus of the processing explained as the so-called multiple-value-ized processing in drawing 10. That is, in half toning processing, the image data which has 256 gradation by which color transform processing was carried out is changed into the image data expressed by the existence of the dot which a color printer 20 can express. Since the color printer 20 of this example can form three kinds of dots of size, inside, and smallness, if half toning processing is performed, one condition of - "a large dot is formed", - [- / "forms a dot" about no pixels / "a small dot is formed"] "an inside dot is formed", will be judged. The various approaches learned widely can be used for half toning processing like the so-called error diffusion method and the so-called systematic dither method. About the half toning processing by the systematic dither method used by this example, it mentions later.

[0060] Termination of half toning processing performs dot size permutation processing (step S204). This processing is processing which rewrites the decision result of half toning processing, as the dot of predetermined magnitude is formed in the pixel extracted by profile pixel extract processing (step S200). The flow chart of dot size permutation processing is shown in drawing 13. Since a profile pixel is already extracted in profile pixel extract processing (step S200) and the extract result is memorized, it judges first whether the pixel (attention pixel) which it is going to process from now on is a profile pixel (step S250). When an attention pixel is a profile pixel, the value Cdr which has memorized the multiple-value-ized result is rewritten to "1" which is the value which shows formation of a small dot" (step S252). Such rewriting is not performed when an attention pixel is not a profile pixel. If such processing is performed about all pixels (step S254), dot size permutation processing will be ended and it will return to the image-processing routine which escaped from the 1st multiple-value-ized processing and was shown in drawing 10. In addition, although the reasonable small dot which can form the small dot 20, i.e., a color printer, is formed in the flow chart shown in drawing 13 when it is a profile pixel, the dot which a profile pixel forms does not necessarily need to be the minimum dot that what is necessary is just a smaller dot. Since three kinds of dots of size, inside, and smallness can be formed, it changes into formation of a small dot and you may make it form an inside dot in the color printer 20 of this example.

[0061] Drawing 14 is the explanatory view showing signs that printing image quality is improved by performing 1st multiple-value-ized processing, when the graphic form of an arrow head is printed as an example. Drawing 14 (a) shows the configuration of the arrow head which it is going to print, and drawing 14 (b) shows signs that the formation existence of a dot was judged for every pixel by half toning processing (step S202 of drawing 12). Since the case where a deep-black arrow head is printed is here assumed [*****] when general, the gradation value of each pixel which constitutes an arrow head is set to 255, and the value "3" which shows that a large dot is formed is set to each corresponding pixel. In addition, the value "0" which shows not forming a dot omitted the graphic display, in order to avoid complicated-ization. Drawing 14 (c) shows the situation of the dot formed on the record medium using the 1st multiple-value-ized processing of this example, and shows the situation of the dot which used the conventional multiple-value-ized processing (multiple-value-ized processing in which the dot of a profile pixel is not changed), and was formed for the comparison to drawing 14 (d).

[0062] If drawing 14 (c) is compared with drawing 14 (d), the arrow head printed using the conventional multiple-value-ized processing is printed by the angle with the comparatively clear corner (CR1) of the bamboo hat of an arrow head when it prints to a corner (CR2) being printed round using the 1st multiple-value-ized processing of this example. The shaft (ST1) of an arrow head seems moreover, not to become thick to a shaft (ST2) becoming thick when it prints also about the part of the shaft of an arrow head using the conventional multiple-value-ized processing, when it prints using the 1st multiple-value-ized processing of this example.

[0063] By performing 1st multiple-value-ized processing of this example, it is based on the following reason that image quality is improved as shown in drawing 14. It is printed using a large dot that it is few, therefore fundamentally that a graphic form, an alphabetic character, etc. are usually expressed with medium gradation. However, by the color printer, as mentioned above, in order to avoid generating of the phenomenon called banding, i.e., the problem which a white muscle occurs [problem] on the boundary line of a pixel, and worsens image quality, the large

dot is set up so that it may become larger than the magnitude of a pixel. Therefore, only a part with a dot larger [the graphic form or alphabetic character which are printed using a large dot] than a pixel will be tough, and an angle will be printed round. On the other hand, in the 1st multiple-value-ized processing of this example, the pixel used as the profile of a graphic form or an alphabetic character is extracted, and the profile part is printed using a small dot. For this reason, generating of the problem that a line becomes thick or a corner becomes round as shown in drawing 14 is avoidable.

[0064] (2) Multiple-value-ized processing of the 2nd multiple-value-ized processing 2nd is an approach used when the information on resolution higher than the resolution at the time of printing can be used in order to raise further printing image quality, such as a graphic form and an alphabetic character. They are the following cases when the information on resolution higher than the resolution at the time of printing can be used. That a rich gradation expression is needed like a natural image having few images which consist of a table, a graph, an alphabetic character, etc., and printing them promptly instead is called for in many cases. For this reason, when printing images, such as a graphic form and an alphabetic character, quick printing may be performed in exchange for deterioration of image quality by making resolution of an image low. For example, it is the case where it reduces the resolution of a main scanning direction to 360dpi when the main scanning direction and the direction of vertical scanning are expressed in the resolution of 720dpi, and image data prints etc. Since the number of pixels which constitutes an image will become half if resolution of a main scanning direction is made into one half, the time amount which the image processing of drawing 10 takes decreases. In addition, since the number of the dots which should be formed on a record medium also decreases, printing time amount can be decreased substantially. In such a case, since the information on the resolution of 720dpi exists, if a main scanning direction and the direction of vertical scanning perform 2nd multiple-value-ized processing of this example using this, it can perform quick printing, without sacrificing printing image quality. Below, although the main scanning direction and the direction of vertical scanning are expressed in the resolution of 720dpi, image data takes for an example the case where reduce only a main scanning direction to 360dpi, and it is printed, and explains the 2nd multiple-value-ized processing of this example.

[0065] Drawing 15 is a flow chart which shows the flow of the 2nd multiple-value-ized processing of this example. The 2nd multiple-value-ized processing consists of four steps greatly so that it may illustrate. The low resolution-ized processing (step S300) performed first is processing the resolution of a main scanning direction is reduced [processing] to 360dpi from 720dpi. The data once changed into the resolution of 720dpi by resolution transform processing (step S102) of drawing 10 are changed into the resolution of 360dpi only in a main scanning direction. In resolution transform processing of step S102, it does not change into 360dpi from the start because the data of the 720dpi resolution by which color transform processing (step S104 of drawing 10) was carried out need to multiple-value-ized [of ** the 2nd of this example] be under processing and it is necessary to refer to them. Moreover, it is because it is more convenient on an image processing to also once change images, such as a graphic form and an alphabetic character, into 720dpi since the main scanning direction is also printed in the resolution of 720dpi about the natural image.

[0066] Drawing 16 is an explanatory view about low resolution-ized processing of this example. The case where the image of drawing 16 (a) is low-resolution-ized as an example is considered. About this image, the resolution of a main scanning direction and the direction of vertical scanning is 720dpi, and it is drawing 16 (b) which was expressed as image data which has 256 gradation. In addition, in order to make drawing legible, in drawing below drawing 16 (b), a slash is given to a pixel with a high gradation value, and the pixel with a low gradation value is displayed by void. In low resolution-ized processing, two pixels which adjoin a main scanning direction are summarized to one big pixel (henceforth, large pixel), and the resolution of main scanning direction 720dpi is reduced in 360dpi resolution. As an example, two pixels summarized to one large pixel are enclosed with a broken line thick in drawing 16 (b), and it is shown. The gradation value of a new large pixel is computed from the gradation value of two pixels using the following formula.

= (Gradation value of a large pixel) max (the gradation value of a left pixel, gradation value of a right pixel)
 max (A, B) is a maximum operator showing taking the one where a value is bigger in A and B here, having taken the minimum value and the average of two pixels -- if -- A1 of drawing 16 (c) -- since a line disappears in the part used as gradation value distribution like [again] A2, the maximum of two pixels is taken. Consequently, drawing 16 (b) is low-resolution-ization-processed as shown in drawing 16 (d). As a result of low-resolution-ization-processing so that clearly if drawing 16 (d) is seen, a level difference becomes large in the part shown by A3 or A4 in drawing, and image quality is deteriorating. The 2nd multiple-value-ized processing of this example is processing which avoids aggravation of such image quality and which is performed for accumulating.

[0067] Termination of low resolution-ized processing (step S300) of drawing 15 performs profile pixel extract processing (step S302). This profile pixel extract processing is processing which extracts the profile which receives the low-resolution-ization-processed gradation image data and is contained in an image. Since various kinds of approaches exist in the extraction method of a profile, it mentions later collectively.

[0068] Termination of profile pixel extract processing (step S302) starts half toning processing (step S304). This half toning processing is the same processing as the half toning processing under 1st multiple-value-ized processing. That is, it is the processing which changes the image data which has 256 low-resolution-ized gradation into the image data expressed by the existence of the dot which a color printer 20 can express. Although it is the part which half toning processing takes the processing time also especially in the image processing which needs to judge the formation existence of a dot about all pixels, and is shown in drawing 10, if it is made to perform half toning processing after low-resolution-izing, the processing time will be shortened greatly. If half toning processing is performed, one condition of -- "a large dot is formed" -- [- / "which does not form a dot" / "a small dot is formed"] an inside dot is formed" will be judged about all pixels.

[0069] Since image quality is deteriorating as previously shown using drawing 16 (d), the image after half toning processing (step S304) termination avoids aggravation of image quality by replacing the dot of the profile section in the 2nd multiple-value-ized processing of this example. Therefore, the dot size which should be replaced about each large pixel used as a profile is determined, and processing which replaces a half toning processing result so that the determined dot may be formed is performed. The profile dot decision processing (step S306) shown in drawing 15 performs such processing.

[0070] Drawing 17 is a flow chart which shows the flow of profile dot decision processing. If profile dot decision processing is started, one profile pixel currently beforehand extracted at step S302 of drawing 15 will be selected, and the gradation value of the former pixel of two which constituted the profile pixel will be acquired. That is, since a profile pixel is a pixel summarized to one by low resolution-ized processing (refer to drawing 16) in two pixels which the image data currently expressed in 720dpi resolution from the first adjoins, it acquires the gradation value (VL) of a left pixel and the gradation value (VR) of a right pixel which became origin. This processing is processing of step S350 of drawing 17.

[0071] Acquisition of the gradation values VL and VR of a former pixel on either side compares them with the predetermined threshold th (step S352). Although the value of a threshold th is selected eventually, looking at printing image quality, the value near [which is half toning processing and is used for formation decision of a large dot] a threshold can be used as a rule of thumb. About the detail of half toning processing, it mentions later. a large dot should be formed in a profile pixel when both of the gradation values of the pixel which constitutes a profile pixel are larger than a threshold th -- ** -- it judges and the value "3" meaning formation of a large dot is assigned to the value Cdr which memorizes the multiple-value-ized result (step S354). an inside dot should be formed in a profile pixel when the gradation value VR which is a right pixel is larger than a threshold th, although the gradation value VL of a left pixel is smaller than a threshold th -- ** -- it judges and the value "2" which means formation of an inside dot in Cdr is assigned (step S356). on the contrary, a small dot should be formed when the gradation

value VR which is a right pixel is small, although the gradation value VL of a left pixel is larger than a threshold $th \sim \sim \sim$ the value "1" which judges and means formation of a small dot in Cdr is assigned (step S358).

[0072] Here, the reason for changing the magnitude of the dot formed according to the gradation value of a pixel on either side is explained. As mentioned above using drawing 7, by adjusting the regurgitation timing of the ink droplet (IPs) which forms a small dot, and the ink droplet (IPm) which forms an inside dot, the color printer 20 of this example forms a small dot and an inside dot in the same pixel, and forms the large dot by this. However, the formation location of the Konaka dot is not necessarily strictly in agreement, and by adjusting the regurgitation timing of ink droplet IPs-IPm, it is set up so that a dot location may shift slightly, as shown in drawing 18. The difference in this dot formation location and the gradation value distribution of a pixel are made to correspond. Since it will be considered the condition that it is shown in A5 in drawing when the gradation value of a pixel on either side is larger than both the thresholds th if the example of drawing 18 (b) explains, a large dot is formed. When [that the gradation value VL of a left pixel is smaller than a threshold th] the gradation value VR of a right pixel is large, since it is considered the condition that it is shown in A6 in drawing, an inside dot is formed, and if the gradation value VR whose gradation value VL of a left pixel is a right pixel greatly is conversely small, since it is considered the condition of A7 in drawing, a small dot will be formed. In addition, if the regurgitation timing of two kinds of ink droplets IPs and IPm is adjusted, relation which showed the physical relationship of the Konaka dot to drawing 18 can also be made reverse. Therefore, the physical relationship of both dots is not limited to what is shown in drawing 18, and from the first, making it reverse may form the Konaka dot in homotopic so that it may mention later. If such processing is performed about all profile pixels (step S360), profile dot decision processing will be ended and it will return to the image-processing routine which escaped from the 2nd multiple-value-ized processing and was shown in drawing 10.

[0073] Drawing 19 is the explanatory view showing signs that printing image quality is improved by performing 2nd multiple-value-ized processing, when the graphic form of the same arrow head as drawing 14 is printed. Drawing 19 (a) shows the arrow head printed without performing low resolution-ized processing, and drawing 19 (b) shows the printing result at the time of performing low resolution-ized processing in which two pixels which adjoin a main scanning direction are summarized to one large pixel. If drawing 19 (b) is seen, by performing low resolution-ized processing shows that image quality is deteriorating so that clearly.

[0074] The printing image at the time of performing 2nd multiple-value-ized processing to drawing 19 (b) is an image shown in drawing 19 (c). Of profile dot decision processing (step S306 of drawing 15), the pixel shown by B1 and B-2 for example, in drawing 19 (b) is an inside dot, and the pixel of B3 is a small dot, and the pixel of B4 is formed by the large dot. Thus, since a formation dot is rewritten based on the gradation value distribution of the pixel which constitutes each profile pixel, it turns out that image quality is improving the case where it prints in the resolution of 720dpi, and more than an EQC. Thus, although image quality improves greatly, the print resolution of a color printer 20 is still 360dpi, and has merely had good control of striking the various dots of size, inside, and smallness in any direction in the profile part of an image. Therefore, the time amount which an image processing takes, and the time amount which dot formation takes increase like [in the case of printing with high resolution], and the evil in which printing takes long duration does not arise.

[0075] Drawing 19 (d) is the explanatory view showing the effectiveness which performed 2nd multiple-value-ized processing, when not shifting the formation location of the Konaka dot. When the formation location of the Konaka dot is not shifted, an image quality improvement effect is not like [which was shown in drawing 19 (c)], but if compared with the image shown in drawing 19 (b), image quality is improved greatly. In addition, although the gradation value (VL, VR) of the pixel of the right and left which constitute a profile pixel shall form an inside dot in the example of drawing 19 (d) which forms the minor dot in homotopic as long as it is larger than neither of threshold th , you may make it form by the small dot.

[0076] Although the pixel which adjoins a main scanning direction is collectively made into the large pixel in the above explanation while shifting and setting the formation location of a minor

dot as the main scanning direction, neither the direction which shifts a dot, nor the direction which summarizes a pixel is necessarily limited to a main scanning direction. For example, a minor dot is formed using a separate nozzle, the pixel which adjoins in the direction of vertical scanning while shifting and setting up a dot location in the direction of vertical scanning is summarized, and, of course, the effectiveness same also as a large pixel obtains.

[0077] (3) In order that multiple-value-ized processing of the 3rd multiple-value-ized processing 3rd may also raise further printing image quality, such as a graphic form and an alphabetic character, like the 2nd multiple-value-ized processing, it is the approach of using the information on high resolution rather than the resolution at the time of printing. However, in the 2nd above-mentioned multiple-value-ized processing, although the information on high resolution was beforehand given as image data, the 3rd multiple-value-ized processing was [multiple-value-ized] under processing, performed interpolation processing, and has made the information on high resolution. Various approaches are learned by the technique of interpolating image data and making the information on high resolution, and if high resolution information is generated using such an approach, even if the image data of high resolution is not given, high-definition printing can be performed. About the detail of interpolation processing, it mentions later. Although the following examples explain as what interpolates to a main scanning direction, when interpolating in the direction of vertical scanning, it can apply similarly. Moreover, after interpolating to a main scanning direction, when interpolating in the direction of vertical scanning further, it can apply.

[0078] Drawing 20 is a flow chart which shows the flow of the 3rd multiple-value-ized processing of this example. The 3rd multiple-value-ized processing consists of four steps greatly so that it may illustrate. It is the same processing as the profile pixel extract processing performed by the profile pixel extract processing (step S400) performed first multiple-value-ized [of the above-mentioned 1st or 2nd] being under processing, and the profile contained in an image is extracted. Since various kinds of approaches exist in the extraction method of a profile, it mentions later collectively.

[0079] Termination of profile pixel extract processing (step S400) starts half toning processing (step S402). This half toning processing is the half toning processing performed by multiple-value-ized [of the 1st or 2nd] being under processing, and the same processing. By performing half toning processing, one condition of "a large dot is formed", - [- / "which does not form a dot" / "a small dot is formed"] "an inside dot is formed", is judged about all the pixels of image data with 256 gradation.

[0080] Termination of half toning processing starts interpolation processing (step S404). Although image data is changed into the transcription by the existence of a dot by half toning processing, in interpolation processing, the existence of a dot is determined about each of the pixel which was made to increase the number of pixels to a main scanning direction, and increased. Interpolation processing of image data is interpolating the image data changed into low gradation (this example four values) by half toning processing in the 3rd multiple-value-ized processing of this example, although interpolating the data which have a 256 gradation value is also considered. Therefore, the time amount which processing will become easy if it compares when interpolating 256 gradation data, and processing takes can also be shortened.

[0081] Drawing 21 is the explanatory view showing the content of the interpolation processing in the 3rd multiple-value-ized processing of this example. As an example, an image as shown in drawing 21 (a) shall be interpolated. When interpolating an image to a main scanning direction, a former image is once divided into two or more pixel trains extended in the direction of vertical scanning, and a new pixel train is inserted between each pixel train. Drawing 21 (b) shows signs that a new pixel train was inserted between each pixel train. The field Int which gave the slash roughly all over drawing is the inserted pixel train. Next, each gradation value is determined about each pixel of the pixel train inserted in this way. Drawing 21 (c) is an explanatory view explaining the decision approach of the gradation value about each pixel. When calculating the gradation value in a certain pixel X in the inserted pixel train Int, based on the gradation value Y1 of the circumference pixel of Pixel X, i.e., a pixel, thru/or the gradation value of Y6, it determines using a degree type.

(Gradation value of Pixel X) = $\frac{Y1 - Y6}{6}$ (gradation value of each pixel of Y1-Y6)

Here, each pixel of Y1 thru/or Y6 can take those four gradation values which form each dot of the Onaka smallness or do not form a dot. The value of Function f can be calculated experimentally, in this example, about all the combination of 4 gradation value which six pixels can take, determines the gradation value of Pixel X beforehand, and has memorized it to ROM. When calculating the gradation value of a certain pixel, the gradation value of six surrounding pixels was acquired first, and the gradation value which corresponds by referring to ROM is determined. Thus, interpolation of each pixel of drawing 21 (b) obtains an image as eventually shown in drawing 21 (d).

[0082] But the pixel of the circumference referred to in case the gradation value of a pixel is calculated is not restricted to six. For example, if the gradation value of ten pixels made to associate with "y" into drawing 21 (c) is referred to in addition to six circumference pixels as mentioned above, a more natural interpolation image can be obtained.

[0083] As shown in drawing 20, the 3rd multiple-value-sized processing of this example starts profile dot decision processing, after ending interpolation processing (step S406). This is processing which improves the dot which should be formed in the profile pixel extracted at step S400 based on the image data of high resolution which made it generate in interpolation processing, and aims at improvement in printing image quality. Detailed processing is the same as the profile dot decision processing in the 2nd multiple-value-sized processing shown in drawing 17, below, diverts the flow chart of drawing 17 and explains the outline of processing. The gradation value of the former pixel which constitutes the introduction profile pixel is acquired (step S about [350]). A former pixel means two pixels which the location of a profile pixel was made to generate by interpolation processing (step S404 of drawing 20) here. The magnitude of the gradation value of the former pixel of two and the predetermined threshold is compared (step S about [352]). If large [two], it will judge that a large dot is formed, and "3" is substituted for the value Cdr showing a multiple-value-sized result (step S about [354]). The gradation value of a left pixel is small, when the gradation value of a right pixel is large, "2" is substituted for Cdr (step S about [356]). and when [that the gradation value of a left pixel is large] the gradation value of a right pixel is small, "1" is substituted for reverse at Cdr (step S about [358]). After ending such processing about all profile pixels (step S about [360]). profile dot decision processing is ended, and it escapes from multiple-value-sized processing, and returns to the image-processing routine of drawing 10.

[0084] Drawing 22 is the explanatory view showing signs that printing image quality is improved by performing 3rd multiple-value-sized processing of this example. Drawing 22 (a) is former image data, and if it prints by performing the usual multiple-value-sized processing, an image as shown in drawing 22 (b) will be obtained. Drawing 22 (c) is an image which shows the result of the interpolation processing explained using drawing 21, and the printing image obtained by performing 3rd multiple-value-sized processing of this example shows to drawing 22 (d). The profile of an image is improved by the smooth profile as a result of having good control of striking each dot of the Onaka smallness in any direction a clear passage based on the information on the high resolution interpolated and obtained, when seeing drawing 22 (d).

[0085] In addition, although above-mentioned explanation explained as that to which the dot formation location of inside and a smallness dot shifts, and is set, it is the same as that of the case of the 2nd multiple-value-sized processing explained previously that the effectiveness of an image quality improvement is acquired even if it forms inside and a smallness dot in homotopic in piles.

[0086] D. In the example explained beyond extract processing of a profile pixel, the profile difference is extracted based on the gradation value of the pixel which adjoins mutually. Drawing 23 is the explanatory view showing the content of profile pixel extract processing in which it used by this example. Based on the gradation value of each pixel, it judges whether an attention pixel is a profile pixel, making into 1 set the attention pixel Pc which is going to judge whether it is a profile pixel, and the forward-addressing pixel Prb and the back reference pixel Pra before and after that, summarizing the group of three pixels, and moving to a main scanning direction, as shown in drawing 23 (a). Hereafter, it explains concretely using drawing 23 (b) thru/or drawing 23 (d).

[0087] Drawing 23 (b) thru/or drawing 23 (d) are image data which has 256 gradation before multiple-value-sized processing—the image of the arrow head of drawing 14 (refer to drawing 10), in order to avoid complicated-ization, the pixel with a high gradation value is a slash, and void has shown the pixel with a low gradation value. For example, when the attention pixel Pc is in the pixel shown by D1 of drawing 23 (b), the gradation value of a forward-addressing pixel is a high gradation value, but since the gradation value of an attention pixel is a low gradation value, it can be judged that the location of a pixel D1 is not a profile location, the case where only 1 pixel of attention pixels moved to the main scanning direction, and it comes to a pixel D2 — (— since both the gradation values of drawing 23 (the condition of c)), the forward-addressing pixel Prb, and the attention pixel Pc turn into a high gradation value, a pixel D2 can be judged to be a thing in a profile location. If only 1 more pixel moves and it comes to a pixel D3 (condition of drawing 23 (d)), since both the gradation values of the attention pixel Pc and the reference pixel of order will turn into a high gradation value, a pixel D3 can be judged to be a thing in the interior of the graphic form instead of a profile.

[0088] The combination of each gradation value of an attention pixel, a forward-addressing pixel, and a back reference pixel and the decision result of whether an attention pixel is a profile pixel are collectively shown in drawing 24 (a). That it is with "L" about the gradation value of a pixel being a high gradation value that it is all over drawing with "H" expresses that it is a low gradation value. As shown in the below-mentioned flow chart, it judges whether the gradation value of a pixel is a high gradation value by comparing with a predetermined threshold. The value "0" of a decision result shows that an attention pixel is not a profile pixel. The value "1" of a decision result or "2" shows that an attention pixel is a profile pixel. When it is a profile pixel, a decision result can take two values ("1", or "2") because it has distinguished, the condition, i.e., the condition that an attention pixel and a forward-addressing pixel are contained in a graphic form, and a back reference pixel is not contained in a graphic form, that a graphic form begins from the location of an attention pixel, and the condition which a graphic form finishes with an attention pixel, i.e., condition that an attention pixel and a back reference pixel be contained in a graphic form, and forward-addressing pixel be contained in a graphic form. Moreover, that it is in drawing 24 (a) with "—" shows that a corresponding gradation value does not exist like, when an attention pixel is in the part of the edge of an image. If the profile pixel of the image shown in drawing 23 (b) is extracted according to this table, a result as shown in drawing 24 (b) will be obtained. In addition, in drawing 24 (b), in order to avoid complicated-ization, the value of a decision result is displayed only about the profile pixel.

[0089] Drawing 25 is a flow chart which shows the flow of the profile pixel extract processing under 1st thru/or 3rd multiple-value-sized processing. Initiation of profile pixel extract processing judges whether the attention pixel is first located in the edge of an image (step S500). When an attention pixel is in the edge of an image, a profile pixel will not be extracted and "0" is substituted for the value Ccn of a decision result (step S502). When there is no attention pixel in the edge of an image, in order to perform extract processing of a profile pixel actually, each gradation value Vc-Vrb-Vra of an attention pixel, a forward-addressing pixel, and a back reference pixel is acquired (step S504). The size relation between the gradation value Vc of an attention pixel and the predetermined threshold then is compared first (step S506), when the gradation value Vc is smaller than a threshold then, it judges that an attention pixel is not a profile pixel, and "0" is substituted for the value Ccn which shows a decision result (step S508). Although the value of a threshold then is selected eventually, looking at printing image quality, the value near [which is half toning processing and is used for formation decision of a large dot] a threshold can be used as a rule of thumb. About the detail of half toning processing, it mentions later.

[0090] When the gradation value Vc is larger than a threshold then, it is thought that an attention pixel is whether it is on the profile of a graphic form or to be in the interior of a graphic form. In such a case, if it refers to drawing 24 (a), and the gradation value of a back reference pixel is "L" at least, it turns out that an attention pixel is "1". Then, the size of the gradation value Vra of a back reference pixel and a threshold then is compared (step S510), and "1" will be substituted for the value Ccn of a decision result if Vra is smaller than a threshold then (step

S512). When V_{ra} is larger than a threshold then, the size of the gradation value V_{rb} and threshold then of a forward-addressing pixel is compared (step S514), and if V_{rb} is large, a value "0" will be assigned to the decision result Cn (step S516). That is, since each gradation value of an attention pixel, a back reference pixel, and a forward-addressing pixel is larger than a threshold then, it is judged that an attention pixel is in the interior of a graphic form. Moreover, if the gradation value V_{rb} of a forward-addressing pixel is smaller than a threshold then, a value "2" will be assigned to the decision result Cn (step S518). Although the attention pixel and the back reference pixel are contained in the graphic form, it is because it can judge that the forward-addressing pixel is not contained in a graphic form. If the above judgments are made about all pixels (step S520), profile pixel extract processing will be ended and it will return to each multiple-value-sized processing (drawing 12, drawing 15, drawing 20).

[0091] Although the gradation value of a pixel on either side was referred to on both sides of the attention pixel, you may make it refer to the pixel which adjoins about four from an attention pixel in extract processing of a profile pixel in which it has explained above. Drawing 26 is a conceptual diagram for explaining the outline of such profile pixel extract processing. About four pixel means four pixels which touch a certain pixel in the side. Drawing 26 (a) is the explanatory view having shown about four pixel which adjoins an attention pixel.

[0092] The same principle as the approach which also mentioned above the approach of extracting a profile pixel with reference to about four pixel can perform. That is, when an attention pixel is in the edge of an image and the gradation value of an attention pixel is a low gradation value, and when all the gradation values of about four pixel turn into a high gradation value, each is judged that an attention pixel is not a profile pixel. When an attention pixel takes a high gradation value and one in about four pixel thru/or three become a high gradation value, it can be judged that an attention pixel is a profile pixel. What is necessary is just to treat the pixel which an attention pixel adjoins up and down according to a forward-addressing pixel, when distinguishing whether it is the profile pixel with which a graphic form finishes whether it is the profile pixel from which a graphic form begins.

[0093] If a profile pixel is extracted from the image shown in drawing 23 (b) with reference to about four pixel, a result as shown in drawing 26 (b) will be obtained. When comparing with the extract result of drawing 24 (b) and a profile pixel is extracted about with reference to four, it turns out that the profile for a base part of the triangle of an arrowhead is also extracted by accuracy, consequently the quality of a printing image improves further. In addition, it is also known widely that there is a concept called about eight to about four others among the concepts of "near". For example, a total of eight pixels which touch a certain pixel with the diagonal line in contact with about eight pixel in the side are said. In an above-mentioned example, it replaces with about four pixel and, of course, you may make it refer to about eight pixel.

[0094] E. Explain briefly the half toning processing used for the half toning processing last by the systematic dither method by this example. The values of the threshold then which is above-mentioned profile pixel extract processing and is used are the following half toning processings, refer to the value of the threshold used in order to judge the formation existence of a large dot, and are chosen. In addition, various approaches are learned about half toning processing, and it is not restricted to the approach explained below in this example, but the approach of these various kinds can be applied.

[0095] Drawing 27 is a flow chart with which a printer driver 92 performs half toning processing using the approach called a systematic dither method. At this example, although half toning processing is performed in parallel for every color of C-M-Y-K, in order to avoid complicated-ization of explanation, the following explanation explains, without specifying a color.

[0096] If half toning processing is started, CPU81 will read image data Cd (step S600). This image data Cd is image data for every color which has 256 gradation after color conversion. Next, with reference to the rate table of dot record of drawing 11 mentioned above, rate Rdl - Rdm - Rds of dot record of each dot of the size, the inside, and smallness to image data Cd is acquired at once (step S602). In addition, the rate Rd of dot record is defined as rate $Rd=of$ dot record 255 in the condition that the dot is formed in all pixels. This is based on the convenience on data processing resulting from a computer 80 expressing data by 8 bits.

[0097] Next, the size of the rate Rdl of dot record of a large dot and the 1st threshold th1 is compared (step S604), and if the rate Rdl of dot record of a large dot is larger, the value "3" meaning forming a large dot in Cdr as a result of multiple-value-sized will be assigned (step S606). The value from which the 1st threshold th1 differs for every pixel by the dither matrix is set up.

[0098] Here, by using drawing 28 explains the view of the half toning processing by the systematic dither method. In order to simplify explanation, a part of image data (pixel of 4x4) is taken out and expressed with drawing 28. When multiple-value-sized the image data Cd which consists of a pixel of length and width 1000x1000, using a systematic dither method, the dither matrix of the same magnitude (length and width 1000x1000) is prepared, and the threshold of 0-255 is set as each pixel of a dither matrix at random. And the gradation value of image data is compared with the threshold of a dither matrix for every pixel to which a location corresponds, and if small to the reverse which will form a dot in the pixel if the gradation value of image data is larger than the threshold of a dither matrix, it will be judged that a dot is not formed.

Corresponding signs that compare the gradation value of image data with the threshold of a dither matrix for every pixel, and the dot is formed only in the pixel with the large gradation value of image data (a hatch way is given and displayed all over drawing 28). It has the same number of pixels as image data, and the ideal dither matrix by which the threshold of 0-255 completely inclined toward each pixel, and was set as it that there is nothing is called white-noise matrix. A white-noise matrix has many pixels, and since there is a problem which uses much memory of a computer 80, the blue noise matrix which inclined toward the matrix of the magnitude of length and width 16x16, and set the threshold of 0-255 as it actually that there is nothing is prepared, and it is used as a dither matrix, shifting the location of a blue noise matrix.

[0099] Based on the systematic dither method explained above, the printer driver 92 of this example changes image data Cd into the rate Rd of dot record about each dot with reference to the rate table of dot record (drawing 11), and is performing half toning processing to the value of the obtained rate Rd of dot record.

[0100] When the rate Rdl of dot record of a large dot is smaller than the 1st threshold th1, the dot formation existence about an inside dot is judged. That is, the size of the rate Rdm of dot record of an inside dot and the 2nd threshold th2 is compared (step S608), and if the rate Rdm of dot record of an inside dot is larger than the 2nd threshold th2, the value "2" showing forming the inside dot of Cdr as a result of multiple-value-sized will be assigned (step S610).

Thus, since the formation existence of an inside dot is judged about the pixel which did not form a large dot, there is nothing a large dot and whose inside dot are the same pixels and that is formed. Moreover, the value of the 2nd threshold th2 which judges the formation existence of an inside dot is set as the dither matrix set to inside dots. When sharing the dither matrix for inside dots with the thing for large dots, there is a possibility of a large dot and inside dot also becoming being also hard to be formed, as a result causing deterioration of image quality in the pixel by which the big value of the 255 neighborhoods is set as the threshold. The printer driver 92 of this example is preparing each dither matrix for every dot of size, inside, and smallness so that this thing cannot be found. Of course, when the need of saving the memory capacity of a computer 80 is high, it is good also as what shares the dither matrix of each dot.

[0101] When the rate Rdm of dot record of an inside dot is smaller than the 2nd threshold th2, the dot formation existence of a small dot is judged. Namely, compare the size of the rate Rds of dot record of a small dot, and the 3rd threshold th3 (step S612), and if the rate Rds of dot record of a small dot is larger than the 3rd threshold th3, the value "1" meaning forming the small dot of Cdr as a result of multiple-value-sized is assigned (step S614), and if the rate Rds of dot record of a small dot is smaller, the value "0" meaning not forming a dot will be assigned to Cdr as a result of multiple-value-sized (step S616). In this way, termination of decision of a dot ends half toning processing about all pixels (step S618).

[0102] As mentioned above, although various kinds of examples have been explained, this invention is not restricted to the example of all above, and can be carried out in various modes in the range which does not deviate from the summary. For example, the software program

(application program) which realizes an above-mentioned function may be supplied and performed to the main memory or external storage of a computer system through a communication line.

[Translation done.]

* NOTICES *

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1. This document has been translated by computer. So the translation may not reflect the original precisely.
2. *** shows the word which can not be translated.
3. In the drawings, any words are not translated.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

- [Drawing 1] It is the outline block diagram of the airline printer of this example.
- [Drawing 2] It is the explanatory view showing the configuration of software.
- [Drawing 3] It is the outline block diagram of the printer of this example.
- [Drawing 4] It is the explanatory view showing the dot formation principle in the printer of this example.
- [Drawing 5] It is the explanatory view showing the nozzle configuration in the printer of this example.
- [Drawing 6] It is an explanatory view explaining the principle which forms the dot from which magnitude differs by the printer of this example.
- [Drawing 7] It is the explanatory view showing the situation of the dot formed of the actuation wave and this actuation wave of a nozzle in the printer of this example.
- [Drawing 8] It is the explanatory view showing the internal configuration of the control unit of the printer of this example.
- [Drawing 9] It is the explanatory view showing signs that the printer head of this example forms a dot in response to data from an actuation buffer.
- [Drawing 10] It is the flow chart which shows the flow of the image-processing routine in this example.
- [Drawing 11] It is the explanatory view showing an example of the rate table of dot record used by this example.
- [Drawing 12] It is the flow chart which shows the flow of the 1st multiple-value-ized processing of this example.
- [Drawing 13] It is the flow chart which shows the flow of the dot size permutation processing in the 1st multiple-value-ized processing of this example.
- [Drawing 14] It is the explanatory view showing the image quality improvement effect by the 1st multiple-value-ized processing of this example.
- [Drawing 15] It is the flow chart which shows the flow of the 2nd multiple-value-ized processing of this example.
- [Drawing 16] It is the explanatory view showing the low resolution-ized processing in the 2nd multiple-value-ized processing of this example.
- [Drawing 17] It is the flow chart which shows the flow of profile dot decision processing.
- [Drawing 18] It is the explanatory view showing an example of the physical relationship of the small dot formed on a record medium, an inside dot, and a large dot.
- [Drawing 19] It is the explanatory view showing the image quality improvement effect by the 2nd multiple-value-ized processing of this example.
- [Drawing 20] It is the flow chart which shows the flow of the 3rd multiple-value-ized processing of this example.
- [Drawing 21] It is the explanatory view showing the outline of the interpolation processing in the 3rd multiple-value-ized processing of this example.
- [Drawing 22] It is the explanatory view showing the image quality improvement effect by the 3rd multiple-value-ized processing of this example.

- [Drawing 23] It is the explanatory view showing the outline of profile pixel extract processing.
- [Drawing 24] It is the explanatory view in which the gradation value of each pixel referred to for a profile pixel extract and the decision result of being a profile pixel were summarized.
- [Drawing 25] It is the flow chart which shows the flow of profile pixel extract processing.
- [Drawing 26] It is an explanatory view explaining how to extract a profile pixel with reference to about four pixel.
- [Drawing 27] It is the flow chart which shows the flow of half toning processing in which it is used in this example.
- [Drawing 28] It is an explanatory view explaining the outline of the half toning processing by the systematic dither method.
- [Description of Notations]
- 20 -- Color printer
- 23 -- CRT
- 24 -- Modem
- 25 -- Flexible disk drive
- 26 -- Hard disk
- 30 -- Carriage motor
- 31 -- Driving belt
- 32 -- Pulley
- 33 -- Sliding shaft
- 34 -- Location detection sensor
- 35 -- Paper feed motor
- 36 -- Platen
- 40 -- Carriage
- 41 -- CPU
- 41 -- Print head
- 42 43 -- Ink cartridge
- 44-47 -- Head for ink regurgitation
- 50 -- Ink path
- 59 -- Control panel
- 60 -- Control circuit
- 61 -- CPU
- 62 -- PROM
- 63 -- RAM
- 64 -- PC interface
- 66 -- Timer
- 67 -- Actuation buffer
- 68 -- Bus
- 69 -- Distribution output machine
- 70 -- Oscillator
- 80 -- Computer
- 81 -- CPU
- 82 -- ROM
- 83 -- RAM
- 84 -- Input interface
- 85 -- Output interface
- 86 -- CRTC
- 87 -- DDC
- 88 -- SIO
- 89 -- Bus
- 90 -- Video driver
- 91 -- Application program
- 92 -- Printer driver

93 -- Resolution conversion module
94 -- Color conversion module
95 -- Multiple-value-sized module
96 -- Interface module

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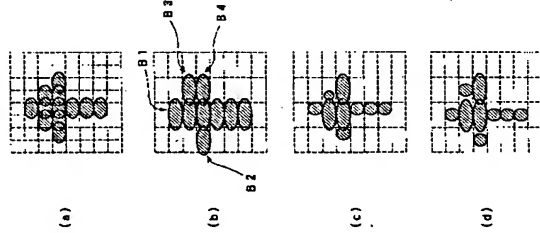
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(54) 【発明の名称】 印刷装置、印刷方法、および記録媒体

(57) 【要約】
【課題】 文字や図形等の画像を印刷した場合に、輪郭が滑らかに印刷されず、また輪郭が太くなる等の問題が生じる場合があった。
【解決手段】 大きさの異なる2種類以上のドットを形成可能な印刷装置において、文字や図形等の輪郭を構成する画像を抽出し、該輪郭画像に小さなドットが形成されるようにする。輪郭部に小さなドットを形成すれば、大きなドットを形成する場合に比べて輪郭を滑らかにすることができ、輪郭が太くなることも回避することができ、また、次のようにすれば更に画質を向上させることができる。まず、形成可能なドットの中で所定の大きさのドットはドット形成位置が所定方向にずれるように設定しておく。輪郭画像を抽出すると、印刷解像度より高解像度の情報を利用して、抽出した画像に形成すべきドットを決定する。高解像度の情報は、画像データとして与えられる場合の他に、補間等の画像処理によって生成することも可能である。



【特許請求の範囲】

【請求項1】 大きさの異なる2種類以上のドットを形成可能なヘッドを備え、主走査と副走査とを行いながら該ヘッドを駆動して画像を印刷する印刷装置であって、前記画像を構成する画像の階調値に基づいて、前記ドットの形成有無を判断するドット形成判断手段と、該判断結果を記憶する判断結果記憶手段と、前記画像に含まれる形状について、その輪郭を構成する画像を抽出する輪郭画像抽出手段と、該輪郭画像には所定の小さなドットが形成されるように、前記記憶されたドット形成判断結果を書き換える判断結果書き換え手段と、該書き換えられた判断結果に基づいて、前記各大きさのドットを形成するドット形成手段とを備えた印刷装置。
【請求項2】 請求項1記載の印刷装置であって、前記輪郭画像抽出手段は、主走査方向に隣接する複数の画像を組として、該組を構成する各画像の階調値と所定の閾値とを比較し、該比較結果と所定の関係とに基づいて前記輪郭画像を抽出する手段である印刷装置。
【請求項3】 大きさの異なる2種類以上のドットを形成可能なヘッドを備え、主走査と副走査とを行いながら該ヘッドを駆動して画像を印刷する印刷装置であって、前記画像を構成している画像のうち、隣接する複数の画像を所定の関係に基づいて大画像にまとめ、該大画像によって前記画像を表現する低解像度化手段と、該大画像の階調値に基づいて、該大画像に形成すべきドットの有無を判断するドット形成判断手段と、該判断結果を記憶する判断結果記憶手段と、前記画像に含まれる形状について、その輪郭を構成する大画像を抽出する輪郭画像抽出手段と、該輪郭画像にまとめられた前記複数の画像の階調値に基づいて、該輪郭画像に形成すべきドットの大きさを決定する輪郭ドット決定手段と、該輪郭画像には該決定された大きさのドットが形成されるように、前記記憶されたドット形成の判断結果を書き換える判断結果書き換え手段と、該書き換えられた判断結果に基づいて、前記各大きさのドットを形成するドット形成手段とを備えた印刷装置。
【請求項4】 請求項3記載の印刷装置であって、前記形成可能なドットの中の所定の大きさのドットは、他のドットに対してドット形成位置を所定方向にずらすて設定されているドットであり、前記輪郭ドット決定手段は、前記輪郭画像にまとめられた複数の画像の階調値分布を解析し、階調値の偏っている方向が前記所定方向と略等しいときには、前記所定の大きさのドットが形成されるよう決定する手段である印刷装置。
【請求項5】 請求項3記載の印刷装置であって、前記低解像度化手段は、前記画像を主走査方向にまとめる手段であり、

前記形成可能なドットの中の所定の大きさのドットは、他のドットに対してドット形成位置を主走査方向にずらすて設定されているドットであり、前記輪郭ドット決定手段は、前記輪郭画像を分割して得られた各小画像の階調値分布を解析し、階調値の偏っている方向が主走査方向と略等しいときには、前記所定の大きさのドットが形成されるよう決定する手段である印刷装置。
【請求項6】 大きさの異なる2種類以上のドットを形成可能なヘッドを備え、主走査と副走査とを行いながら該ヘッドを駆動して画像を印刷する印刷装置であって、前記画像を構成する画像の階調値に基づいて、前記ドットの形成有無を判断するドット形成判断手段と、該判断結果を記憶する判断結果記憶手段と、前記画像に含まれる形状について、その輪郭を構成する画像を抽出する輪郭画像抽出手段と、前記輪郭画像には該決定された大きさのドットが形成されるように、前記記憶されたドット形成の判断結果を書き換える判断結果書き換え手段と、該書き換えられた判断結果に基づいて、前記各大きさのドットを形成するドット形成手段とを備えた印刷装置。
【請求項7】 請求項6記載の印刷装置であって、前記形成可能なドットの中の所定の大きさのドットは、他のドットに対してドット形成位置を所定方向にずらすて設定されているドットであり、前記輪郭ドット決定手段は、前記輪郭画像を分割して得られた各小画像の階調値分布を解析し、階調値の偏っている方向が前記所定方向と略等しいときには、前記所定の大きさのドットが形成されるよう決定する手段である印刷装置。
【請求項8】 請求項6記載の印刷装置であって、前記高解像度化手段は、前記画像を主走査方向に分割する手段であり、
【請求項9】 大きさの異なる2種類以上のドットを形成可能なヘッドを備え、主走査と副走査とを行いながら該ヘッドを駆動して画像を印刷する印刷方法であって、

前記画像を構成する画素の階調値に基づいて、前記ドットの形成有無を判断するとともに該判断結果を記憶しておき、

前記画像に含まれる形状について、その輪郭を構成する画素を抽出し、
該抽出した輪郭画素には所定の小さなドットが形成されるように、前記記憶しておいたドット形成有無の判断結果を書き換え、

該書き換えられた判断結果に基づいて、前記各大きさのドットを形成する印刷方法、

【請求項10】 大きさの異なる2種類以上のドットを形成可能なヘッドを備え、主走査と副走査とを行いながら該ヘッドを駆動して画像を印刷する印刷方法であって、

前記画像を構成している画素のうち、隣接する複数の画素を所定の関係に基づいて大画素にまとめ、該大画素に

よって前記画像を表現し、
該大画素の階調値に基づいて、該大画素に形成すべきドットの有無を判断するとともに該判断結果を記憶しておく

き、
前記画像に含まれる形状について、その輪郭を構成する大画素を抽出し、

該輪郭画素には該決定された大きさのドットが形成されるように、前記記憶しておいたドット形成有無の判断結果を書き換え、

該書き換えられた判断結果に基づいて、前記各大きさのドットを形成する印刷方法、

【請求項11】 大きさの異なる2種類以上のドットを形成可能なヘッドを備え、主走査と副走査とを行いながら該ヘッドを駆動して画像を印刷する印刷方法であって、

前記画像を構成する画素の階調値に基づいて、前記ドットの形成有無を判断するとともに該判断結果を記憶しておき、

前記画像に含まれる形状について、その輪郭を構成する画素を抽出し、

前記画像を隣接する複数の小画素に分割し、該小画素の各階調値を所定の関係に基づいて定め、

前記輪郭画素を分割して得られた各小画素の階調値に基づいて、該輪郭画素に形成するドットの大きさを決定し、

該輪郭画素には該決定した大きさのドットが形成されるように、前記記憶しておいたドット形成有無の判断結果を書き換え、

該書き換えられた判断結果に基づいて、前記各大きさのドットを形成する印刷方法、

【請求項12】 大きさの異なる2種類以上のドットを

形成して画像を印刷する印刷装置で用いられ、該各ドットの形成有無を判断するために前記画像のデータに所定の処理を施すプログラムを、コンピュータで読み取り可能な記憶した記録媒体であって、

前記画像を構成する画素の階調値に基づいて、前記ドットの形成有無を判断するとともに該判断結果を記憶しておく機能と、

前記画像に含まれる形状について、その輪郭を構成する画素を抽出する機能と、

該抽出した輪郭画素には所定の小さなドットが形成されるように、前記記憶しておいたドット形成有無の判断結果を書き換える機能とを実現するプログラムを記録した記録媒体、

【請求項13】 大きさの異なる2種類以上のドットを形成して画像を印刷する印刷装置で用いられ、該各ドットの形成有無を判断するために前記画像のデータに所定の処理を施すプログラムを、コンピュータで読み取り可能な記憶した記録媒体であって、

前記画像を構成している画素のうち、隣接する複数の画素を所定の関係に基づいて大画素にまとめ、該大画素に

よって前記画像を表現する機能と、
該大画素の階調値に基づいて、該大画素に形成すべきドットの有無を判断するとともに該判断結果を記憶しておく機能と、

前記画像に含まれる形状について、その輪郭を構成する大画素を抽出する機能と、

該輪郭画素には該決定された大きさのドットが形成されるように、前記記憶しておいたドット形成有無の判断結果を書き換える機能とを実現するプログラムを記録した記録媒体、

【請求項14】 大きさの異なる2種類以上のドットを形成して画像を印刷する印刷装置で用いられ、該各ドットの形成有無を判断するために前記画像のデータに所定の処理を施すプログラムを、コンピュータで読み取り可能な記憶した記録媒体であって、

前記画像を構成する画素の階調値に基づいて、前記ドットの形成有無を判断するとともに該判断結果を記憶しておく機能と、

前記画像に含まれる形状について、その輪郭を構成する画素を抽出する機能と、

前記画像を互いに隣接する複数の小画素に分割し、該小画素の各階調値を所定の関係に基づいて定める機能と、

前記輪郭画素を分割して得られた各小画素の階調値に基づいて、該輪郭画素に形成するドットの大きさを決定する機能と、

該輪郭画素には該決定した大きさのドットが形成されるように、前記記憶しておいたドット形成有無の判断結果

を書き換える機能とを実現するプログラムを記録した記録媒体、

【発明の詳細な説明】

【0001】
【発明の属する技術分野】この発明は、記録媒体上にドットを形成して各種の画像を印刷する技術に関し、詳しくは画像に含まれる形状の輪郭部分でドットの形成を制御することによって、画質を向上させる技術に関する。

【0002】
【従来の技術】自然画像や文字・図形等、コンピュータから出力される各種画像の出力装置として、記録媒体上にインクなどのドットを形成して画像を印刷する印刷装置が広く使用されている。このような印刷装置は、画像を細かな画素に分割し、各画素の階調値に応じて記録媒体上にドットを形成することによって、各種の画像を印刷している。すなわち、印刷画像の暗い部分（画素の階調値が低い部分）ではドットが形成され、また印刷画像の明るい部分（階調値の低い部分）ではドットが形成されにくいように、各階調値に応じて画素毎にドットの形成有無を判断し、それぞれの画素位置にドットを形成する。こうして印刷されたドットを画素全体としてみれば、形成されているドットの粗密に応じて画像の明暗が変化し、幅広い階調値を有する画像が印刷されることになる。

【0003】印刷画像の暗い部分では、高密度でドットが形成されるよう制御される結果、記録媒体上でのほとんどの画素位置にドットが形成される。このときに、形成されるドットの大きさが小さいと、画素の境目の部分で筋状に間隔が生じて画質が低下する、いわゆるバンディ

ングの問題が生じるため、記録媒体上に形成されるドットの大きさは、通常、記録媒体上での画素間隔よりも大きくするように設定されている。

【0004】また、最近では記録媒体上に形成するドットの大きさを、積極的に制御しない場合は、個々の画素ではドットが形成されているか否かの2つの状態しか表現し得ないが、ドットの大きさを制御すれば1つの画素でより多くの状態を表現することが可能となり、その結果、豊かな階調表現を実現することができる。すなわ

ち、階調値の低い画素には大きなドットを形成し、階調値の高い画素には小さなドットを形成するようにすれば、単にドットの粗密により階調を表現する場合に比べて、階調表現の自由度を広げることができ、幅広い階調値を有する自然画像をより高画質で印刷することが可能となる。

【0005】
【発明が解決しようとする課題】しかし、これらの印刷装置を用いて図形や文字などの画像を印刷した場合に、図形や文字等の輪郭が、実際よりも太く印刷される場合があるという問題があった。すなわち、図形や文字等は

通常は黒色で表現されるので階調値が高く、従って大きなドットで形成されており、印刷された輪郭が実際よりも大きく設定されているため、かといって、ドットの大き

さを小さめに設定すれば、バンディングが生じ、また印刷された輪郭が実際の輪郭よりも太く設定されているため、印刷された輪郭が実際よりも大きく設定されているため、かといって、ドットの大き

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することを要旨とする。

【0010】かかる第1の印刷装置および印刷方法においては、前記画像を構成している画素のうち、隣接する複数の画素を所定の関係に基づいて大画素にまとめ、該大画素によって前記画像を表現し、該大画素の階調値に基づいて、該大画素に形成すべきドットの有無を判断するとともに該判断結果を記憶しておき、前記画像に含まれる形状について、その輪郭を構成する大画素を抽出し、該輪郭画素にまとめられた前記複数の画素の階調値に基づいて、該輪郭画素に形成すべきドットの大きさを決定し、該輪郭画素には該決定された大きさのドットが形成されるように、前記記憶しておいたドット形成有無の判断結果を書き換え、該書き換えられた判断結果に基づいて、前記各大きさのドットを形成することを要旨とする。

【0015】かかる第2の印刷装置および印刷方法においては、画像を構成している画素のうち、隣接する複数の画素を所定の関係に基づいて1つの大画素にまとめ、前記画像を大画素によって表現する。次いで、各大画素の階調値に基づいて、それぞれの画素に形成すべきドットを判断すると共に、画像中で形状の輪郭を構成している大画素を抽出する。抽出された大画素については、該大画素を構成している複数の画素の階調値に基づいて形成すべきドットの大きさを決定し、該決定した大きさのドットが形成されるように、ドットの判断結果を変更する。こうした決定したドット形成の判断結果に基づいて、記録媒体上にドットを形成すれば、輪郭部分が画面にまとめられた複数の画素の情報に反映されたドットによって印刷されるので、輪郭が滑らかとなり印刷画質を向上させることができる。

【0016】また、かかる第2の印刷装置および印刷方法においては、輪郭を構成する大画素のドットの大きさを適切な大きさに変更しているだけであり、画像の印刷に要するドットの数を増加させることはない。従って、高画質で印刷することが可能であるにもかかわらず、印刷に要する時間が増加することがない。

【0017】第2の印刷装置および印刷方法においては、次のようにすることも好適である。該印刷装置が形成可能な各種大きさのドットの中、所定の大きさのドットについては、ドットの形成位置を所定方向にずらして設定しておく。輪郭画素に形成すべきドットの大きさを決定するに際しては、該輪郭画素を構成する複数の画素の階調値分布を解析し、階調値の偏っている方向が前記所定の方向と略一致している場合には、前記方向の大きさのドットを形成するように決定する。このようにすれば、印刷画像の輪郭を構成するドットを、より好ましい位置に形成することができるので、滑らかな輪郭の印刷画像を得ることができる。

【0014】また、上記印刷装置に於いては、本発明の第2の印刷方法は、大きさの異なる2種類以上のドットを形成可能なヘッドを備え、主走査と副走査とを行いながら、前記各大きさのドットを形成することを要旨とする。

要する時間が増加することはない。

【0018】また、第2の印刷装置および印刷方法においては、形成可能な各種大きさのドットの中、所定の大きさのドットについては、ドットの形成位置を主走査方向にずらして設定しておいてもよい。輪郭画素を構成する複数の画素の階調値分布が主走査方向に偏っている場合は、該輪郭画素には所定の大きさのドットを形成するように決定する。このように、より好ましい位置に形成することができ、滑らかな輪郭の印刷画像を得ることができる。

【0019】前述の問題の少なくとも一部を解決するために、本発明の第3の印刷装置は、次の構成を採用した。すなわち、本発明の第3の印刷装置は、大きさの異なる2種類以上のドットを形成可能なヘッドを備え、主走査と副走査とを行いながら該ヘッドを駆動して画像を印刷する印刷装置であって、前記ドットを構成する画素の階調値に基づいて、前記ドットの形成有無を判断するドット形成判断手段と、該判断結果を記憶する判断結果記憶手段と、前記画像に含まれる形状について、その輪郭を構成する画素を抽出する輪郭画素抽出手段と、前記画素を構成する複数の小画素に分割し、該小画素の各階調値を所定の関係に基づいて定めた階調値化手段と、前記輪郭画素を分割して得られた各小画素の階調値に基づいて、該輪郭画素に形成するドットの大きさを決定する輪郭ドット決定手段と、該輪郭画素には該決定した大きさのドットが形成されるように、前記記憶されたドット形成判断結果を書き換える判断結果書換手段と、該書き換えられた判断結果に基づいて、前記各大きさのドットを形成するドット形成手段とを備えることを要旨とする。

【0020】また、上記印刷装置に於いては、本発明の第3の印刷方法は、大きさの異なる2種類以上のドットを形成可能なヘッドを備え、主走査と副走査とを行いながら該ヘッドを駆動して画像を印刷する印刷装置であって、前記画像を構成する画素の階調値に基づいて、前記ドットの形成有無を判断するとともに該判断結果を記憶しておき、前記画像に含まれる形状について、その輪郭を構成する画素を抽出し、前記画像を構成する複数の小画素に分割し、該小画素の各階調値を所定の関係に基づいて定め、前記輪郭画素を分割して得られた各小画素の階調値に基づいて、該輪郭画素には該決定した大きさのドットを形成するように、前記記憶しておいたドット形成有無の判断結果を書き換え、該書き換えられた判断結果に基づいて、前記各大きさのドットを形成することを要旨とする。

【0021】かかる第3の印刷装置および印刷方法においては、画像を構成する画素の階調値に基づいて、各画素に形成すべきドットを判断すると共に、画像中に表現

された形状について、その輪郭を構成している画素を抽出する。次いで、抽出した画素を隣接する複数の小画素に分割し、各小画素の階調値を所定の関係に基づいて定める。こうした求めた各小画素の階調値に基づいて、該輪郭画素に形成すべきドットの大きさを決定し、該決定した大きさのドットが形成されるように、ドットの判断結果を変更する。こうした決定したドット形成の判断結果に基づいて、記録媒体上にドットを形成すれば、輪郭部分は各小画素の情報に反映されたドットによって印刷されるので、輪郭が滑らかとなり印刷画質を向上させることができる。

【0022】また、かかる第3の印刷装置および印刷方法においては、輪郭を構成する画素のドットの大きさを変更しているだけであり、画像の印刷に要するドットの数を増加させることはない。従って、高画質で印刷することが可能であるにもかかわらず、印刷に要する時間が増加することがない。

【0023】第3の印刷装置および印刷方法においては、形成可能な各種大きさのドットの中、所定の大きさのドットについては、ドットの形成位置を所定方向にずらしておくようにしてもよい。輪郭画素を構成した複数の画素を構成するに際しては、該輪郭画素を分割した複数の小画素の階調値分布を解析し、階調値の偏っている方向が前記所定の方向と略一致している場合には、前記所定の大きさのドットを形成するように決定する。こうした大きさのドットを形成するに際しては、該輪郭画素を構成するドットを、より適した位置に形成することは、輪郭部分が滑らかとなり印刷画質を向上させることができる。また、かかる印刷装置および印刷方法においては、画像の印刷に要するドットの数を増加させることはない。従って、高画質で印刷することが可能であるにもかかわらず、印刷に要する時間が増加することはない。

【0024】また、第3の印刷装置および印刷方法においては、所定の大きさのドットについては、ドットの形成位置を主走査方向にずらしておいてもよい。輪郭画素を分割した複数の小画素の階調値分布が主走査方向に偏っている場合は、位置をずらした大きさのドットを形成するように決定する。こうすれば、印刷画像の輪郭を構成するドットを、より好ましい位置に形成することができ、滑らかな輪郭の印刷画像を得ることができる。

【0025】以上の、第1ないし第3の印刷方法および印刷方法は、大きさの異なる2種類以上のドットを形成可能なヘッドとコンピュータとを備えた印刷装置において、該コンピュータに各種制御を行わせることによって、該コンピュータに各種制御を行わせる、上述の各種機能を実現するプログラムを、コンピュータで読み取り可能な記憶した記録媒体としての形態も含まれている。すなわち、本発明の第1の印刷装置および印刷方法に於いては、第1の記録媒体は、大きさの異なる2種類以上のドット

精判部の画質を改善することができる。

【0029】

【発明の実施の形態】 A. 装置の構成

本発明の実施の形態を、実施例に基づいて説明する。図1は、本発明の実施例において使用される印刷装置の構成を示す説明図である。図示するように、この印刷装置は、コンピュータ80にカラースキヤナ21とカラープリンタ20とが接続されており、コンピュータ80に所定のプログラムがロードされて実行される。印刷により、全体として印刷装置として機能する。印刷しようとするカラー原稿は、コンピュータ80が読取可能なカラー画像データORGにカラースキヤナ21で変換された後、コンピュータ80に入力される。コンピュータ80は、所定の画像処理を行って、カラー画像データORGをプリンタで印刷可能な画像データに変換し、カラープリンタ20に出力する。コンピュータ80が扱う画像データは、カラースキヤナ21で取り込んだ画像の他に、コンピュータ80上で各種のアプリケーションプログラム91により作成した画像や、カラースキヤナ21から取り込んだ画像に加工を加えた画像等も用いられる。これら画像データFNLとして、カラープリンタ20に出力され、この画像データFNLに従って、カラープリンタ20は印刷用紙上に各色のインクドットを形成する。この結果、コンピュータ80から出力されたカラー画像データに対応したカラー画像が、印刷用紙上に得られることになる。

【0030】コンピュータ80は、各種の演算処理を実行するCPU81・ROM82・RAM83・入力インターフェース84・出力インターフェース85・CRTコントローラ(CRTC)86・ディスクコントローラ(DDC)87・シリアル入出力インターフェース(SIO)88等から構成されており、これらはバス89で接続されて相互にデータのやり取りが可能となっている。CRTC86はカラー表示可能なCRT23への信号出力を制御し、DDC87はフレキシブルディスクドライブ25やハードディスク26あるいは図示しないCD-ROMドライブ等とのデータのやり取りを制御する。ROM82やハードディスク26には、RAM83にロードされたCPU81で実行される各種のプログラムや、デバイスドライバの形式で提供される各種のプログラムが記憶されている。また、SIO88をモデム24を經由して公衆電話回線PNTに接続すれば、外部のネットワーク上にあるサーバSVから必要なデータやプログラムをハードディスク26にダウンロードすることが可能となる。

【0031】コンピュータ80に電源を投入すると、ROM82およびハードディスク26に記憶されていたオペレーティングシステムが起動し、オペレーティングシステムの下で、各種アプリケーションプログラム

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91が動くようになっている。

【0032】カラープリンタ20は、カラー画像の印刷が可能なるプリンタであり、本実施例では、印刷用紙上にシアン・マゼンタ・イエロ・ブラックの合計4色のインクを吐出することによってカラー画像を印刷するインクジェットプリンタを使用している。もちろん、これら4色インクの他に、ライトシアン・ライトマゼンタのインクを加えた合計6色のインクを使用するカラープリンタであっても構わない。但し、本発明はインクを吐出してドットを形成するカラープリンタに限定されるものではなく、例えば昇華型あるいは溶融型の熱転写方式でドットを形成するカラープリンタであっても構わない。また、本実施例で使用したインクジェットプリンタのインク吐出方式は、後述するようにビエゾ素子PZを用いる方式を採用しているが、他の方式によりインクを吐出するヘッドを備えたプリンタを用いるものとしてもよい。例えば、インク通路に配置したヒータに通電し、インク通路内に発生する泡(バブル)によってインクを吐出する方式のプリンタに適用するものとしてもよい。

【0033】また、本実施例のカラープリンタ20は、バリエーションのプリンタ、すなわち大きさの異なる大小の3種類のドットを、各色毎に形成することが可能なプリンタである。バリエーションのドットプリンタを使用して、形成するドットの大きさを変えれば、ドット毎に多量の階調を表現することが可能となるので、豊かな階調表現の画像を印刷することができる。尚、本実施例のカラープリンタ20は、インクの吐出方法を工夫することによって、単一のインク吐出ノズルを用いて3種類の大きさのドットを形成している。かかるインクの吐出方法については後述する。また、インク吐出方法の説明から明かす通り、ドットの大きさは3種類に限られるものではなく、必要に応じて更に多種類のドットを形成するものでもあって構わない。

【0034】図2は、本印刷装置のソフトウェアの構成を概念的に示すブロック図である。コンピュータ80においては、すべてのアプリケーションプログラム91はオペレーティングシステムの下で動作する。オペレーティングシステムには、ビデオドライバ90やプリンタドライバ92が組み込まれていて、各アプリケーションプログラム91から出力される画像データは、これらのドライバを介して、カラープリンタ20に出力される。画像の加工を行うラテンダッチ等のアプリケーションプログラマ91は、カラースキヤナ21から取り込んだ画像をビデオドライバ90を介してCRT23に表示させ、画像を確認しながら所定の加工を行うことができる。

【0035】アプリケーションプログラム91が印刷命令を發すると、コンピュータ80のプリンタドライバ92は、アプリケーションプログラム91から画像データを受け取って所定の画像処理を行い、プリンタが印刷可能な画像データに変換する。図2に概念的に示すように

プリンタドライバ92が行う画像処理は、解像度変換モジュール93と、色変換モジュール94と、多値化モジュール95と、インターレースモジュール96の大きく4つのモジュールから構成されている。各モジュールで行う画像処理の内容は後述するが、プリンタドライバ92が受け取った画像データはこれらモジュールで変換された後、最終的な画像データFNLとしてカラープリンタ20に出力される。尚、本実施例のカラープリンタ20は、画像データFNLに従ってドットを形成する役割を果たすのみであり画像処理は行っていないが、もちろん、カラープリンタ20で画像変換の一部を行うものであってもよい。

【0036】図3に、本実施例のカラープリンタ20の概略構成を示す。このカラープリンタ20は、図示するように、キャリッジ40に搭載された印字ヘッド41を駆動してインクの吐出およびドット形成を行う機構と、このキャリッジ40をキャリッジモータ30によってプリンタ36の軸方向に往復動させる機構と、紙送りモータ35によって印刷用紙Pを搬送する機構と、制御回路60とから構成されている。キャリッジ40をプラテン60とから構成されている。キャリッジ40はプラテン36の軸方向に往復動させる機構は、プラテン36と並行に架設されたキャリッジモータ30の間に無端の指動輪33と、キャリッジモータ30との間に無端の駆動ベルト31を張設するプーリ32と、キャリッジ40の原点位置を検出する位置検出センサ34等から構成されている。印刷用紙Pを搬送する機構は、プラテン36と、プラテン36を回転させる紙送りモータ35と、図示しない給紙補助ローラと、紙送りモータ35の回転をプラテン36および給紙補助ローラに伝えるギヤトレイン(図示省略)とから構成されている。制御回路60は、プリンタの操作パネル59と信号をやり取りしつつ、紙送りモータ35やキャリッジモータ30、印字ヘッド41の動きを適切に制御している。カラープリンタ20に供給された印刷用紙Pは、プラテン36と給紙補助ローラの間に挟み込まれるようにセットされ、プラテン36の回転角度に応じて所定量だけ送られる。

【0037】キャリッジ40には黒(K)インクを収納するインクカートリッジ42と、シアン(C)・マゼンタ(M)・イエロ(Y)のインクを収納するインクカートリッジ43とが装着されている。もちろん、Kインクとイエロとを同じインクカートリッジに収納させる等しもよい。複数のインクを1つのカートリッジに収納可能とすれば、インクカートリッジをコンパクトに構成することができ、キャリッジ40の下部にある印字ヘッド41には、K・C・M・Yの各インクに対して、インク吐用ヘッド44・45・46・47がそれぞれ形成されている。キャリッジ40の底部には図示しない導管が各インク毎に立設されており、キャリッジ40にインクカートリッジを装着すると、カートリッジ内の各インクは導管を通じて、それぞれのインク吐用ヘッド

16 ノズルへのインクの供給速度には限界があるため、インク通路50の拡大に対してインクの供給量が不足し、図6の状態Aに示した通り、インク界面MeはノズルNzの内側にへこんだ状態となる。また、図6の裏線で示す駆動波形を用いて区間d1に示すように電圧を急激に低くすると、インクの供給量が更に不足して、状態aで示すように状態Aに比べて大きく内側にへこんだ状態となる。

10 【0042】次に、ピエゾ素子PPEに高い電圧を印加すると(区間d3)、インク通路50の断面積の減少により通路内のインクが圧縮され、インク滴がインクノズルから吐出される。このとき、インク供給量が不足しているとは吐出されるインク滴も小さくなる。従って、インク界面があまり内側にへこんでいない状態(状態A)から吐出され、インク界面Cに示すごとく大きなインク滴が吐出され、インク界面bおよび状態cに示すごとく小さなインク滴から吐出される。このように、駆動電圧を低くする際(区間d1、d2)の変化率を変えれば、形成されるドット16の大きさを変化させることができる。

20 【0043】カラープリンタ20は、2種類の駆動波形を連続的に出力する。この様子を図7に示した。電圧を低くする際の変化率を比べれば、駆動波形W1とW2は、それぞれ小さなインク滴Ipsと大きなインク滴Ipmとに対応していることが分かる。キャリアッジ40が主走査方向に移動しながら、駆動波形W1を出力し、次に駆動波形W2を出力する場合を考えると、駆動波形W1により吐出される小さなインク滴Ipsは飛翔速度が比較的小さく、駆動波形W2により吐出される大きなインク滴Ipmは飛翔速度が大きいため、吐出されたから印刷用紙に到着するまでの所要時間は、小さなインク滴Ipsの方が長くなる。当然、インクの吐出位置から印刷用紙に到着した位置の主走査方向へ移動距離も、小さなインク滴Ipsの方が大きなインク滴Ipmより長くなる。従って、駆動波形W1と駆動波形W2のタイミングを調整すれば、図7に示すように、小さなインク滴Ipsと大きなインク滴Ipmとを同一画素に吐出することが可能となる。尚、本実施例のカラープリンタ20では、図7に示すように、同一画素に形成した場合に小ドットと中ドットの形成位置が主走査方向に偏るにずれが設定されている。

30 【0044】本実施例のカラープリンタ20では、駆動波形W1のみをピエゾ素子PPEに供給することによって小さなドットを、駆動波形W2のみをピエゾ素子PPEに供給することによって中ドットを、駆動波形W1とW2をともに供給し、2つのインク滴を同一画素に吐出することによって大ドットを形成している。もちろん、駆動波形の種類を増やすことによって、更に多種類の大きなドットを形成することも可能である。

40 【0045】図8は、カラープリンタ20の制御回路60の内部構成を示す説明図である。図示するように、制御回路60の内部には、CPU61・PROM62・RAM63・コンピュータ80とのデータのやり取りを行うリッジモータ30等とデータのやり取りを行う周辺機器入出力部(P10)65・タイマ66・駆動パルファ67等が設けられている。駆動パルファ67は、インク吐出用ヘッド44ないし47に使用される。これらは互いにバス68で接続され、相互にデータにやり取りが可能となっている。また、制御回路60には、所定周波数で駆動波形を出力する発振器70、および増幅器70からの出力をインク吐出用ヘッド44ないし47に所定のタイミングで分配する分配出力器69も設けられている。

【0046】図8に示す構成を有する制御回路60は、コンピュータ80から画像データFNLを受け取ると、ドットのオン・オフ信号を一時RAM63に蓄え、CPU61は、送送りモータ35やキャリアッジモータ30の動きと同調を採りながら、所定のタイミングでドットデータを駆動パルファ67に出力する。

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【0047】次に、CPU61が駆動パルファ67にドットデータのオン・オフ信号を出力することによって、ドットが吐出されるメカニズムについて説明する。図9は、インク吐出用ヘッド44ないし47の1つのノズル列を例にとって、その接続を示す説明図である。インク吐出用ヘッド44ないし47のノズル列は、駆動パルファ67をソース側とし、分配出力器69をシンク側とする回路に接続されており、ノズル列を構成する各ピエゾ素子PPEは、その電圧の一方が駆動パルファ67の各出力端子Eに、他方が一括して分配出力器69の出力端子に、それぞれ接続されている。分配出力器69からは、図9に示す通り、発振器70の駆動波形が出力されている。CPU61が駆動パルファ67に、各ノズル毎のドットのオン・オフ信号を出力すると、オン信号を受け取ったピエゾ素子PPEだけが駆動波形によって駆動される。この結果、駆動パルファ67からオン信号を受け取っていたピエゾ素子PPEのノズルから一斉にインク粒子Ipが吐出される。

【0048】以上のようなハードウェア構成を有するカラープリンタ20は、キャリアッジモータ30を駆動することによって、各色のインク吐出用ヘッド44ないし47を印刷用紙Pに対して主走査方向に移動させ、また送りモータ35を駆動することによって、印刷用紙Pを副走査方向に移動させる。制御回路60の制御の下、キャリアッジ40の主走査および副走査を繰り返しながら、適切なタイミングで印字ヘッド41を駆動することによって、カラープリンタ20は印刷用紙上にカラー画像を印刷している。

【0049】B. 画像処理の概要

上述のように、カラープリンタ20は、画像データFNLの供給を受けてカラー画像を印刷する機能を有するが、画像データFNLは、コンピュータ80がカラー画像に所定の画像処理を行って生成する。図10はコンピュータ80のプリンタドライバ92内で、CPU81が行う画像処理の概要を示すフローチャートである。以下、図10に従って、画像処理の概要を説明する。

【0050】画像処理を開始するとCPU81は、画像データを入力する(ステップS100)。この画像データは図2で説明したようにアプリケーションプログラム91から供給されるデータであり、画像を構成する各画素毎にR・G・Bそれぞれの色について、0~255の値の256階調を有するデータである。この画像データの階調値は、原画像のデータORGの階調値等に応じて変化する。

【0051】CPU81は、入力された画像データの階調値をカラープリンタ20が印刷するための階調値に変換する(ステップS102)。画像データの階調値が印刷階調値よりも低い場合には、線形補間により補換する。原画像データの間に新たなデータを生成することで階調値変換を行う。逆に画像データでデータを間引くことにより高い階調値変換を行う。

【0052】次に、CPU81は色変換処理を行う(ステップS104)。色変換処理とはR・G・Bの階調値からなる画像データをカラープリンタ20で使用するC・M・Y等の各色の階調値のデータに変換する処理である。この処理は、色変換テーブルLUTを用いて行われる(図2参照)。LUTにはR・G・Bのそれぞれ組合せからなる色をカラープリンタ20で表現するためのC・M・Y・Kの組合せが記憶されている。色変換テーブルを用いて色変換を行う処理自体については、公知の種々の技術が適用可能であり、例えば補間演算による処理が適用できる。

【0053】色変換処理を終了すると多値化処理を開始する(ステップS106)。本実施例においては、色変換後の画像データはC・M・Y・Kの4色の256階調画像となっている。一方、本実施例のカラープリンタ20では、「ドットを形成しない」、「小ドットを形成する」、「中ドットを形成する」、「大ドットを形成する」の合計4つの状態しか採り得ない。従って、256階調を有する画像を、カラープリンタ20が表現できる4階調で表現された画像に変換する必要がある。このよう

な変換を行う処理が多値化処理である。すなわち、記録媒体上で大・中・小の各ドットの形成され易さを、原画像の階調値に依りて変換させることによって、原画像の256階調をカラープリンタ20が表現可能な4階調値で表現するのである。図11は、原画像の階調値に応じて、大・中・小の各ドットのドット記録率が変化していき、ドット密度を示す説明図である。ドット記録率は、ある

しようとする状況に応じて種々の方法を使い分けることができる。もともと単純な方法としては、輪郭画素の形成されるドットを単に小さなドットに置き換える方法がある。これだけでも印刷画質を向上させることができるが、更なる画質の向上を図る印刷時の画像解像度より高い解像度の情報を利用する方法もある。この方法の中にも、詳しく見れば、高解像度の情報を画像データとして外部から取り込む方法もあれば、多値化処理を行わずに内部で生成させる方法もある。以下に、これら3つの方法について簡単に説明する。

【0058】(1) 第1の多値化処理

第1の多値化処理は、もともと単純な方法として先に述べた方法に相当する処理である。第1の多値化処理の流れを示すフローチャートを図12に示す。図示するように第1の多値化処理は大きく3つのステップから構成されている。初めに行う輪郭画素抽出処理(ステップ200)は、色変換処理(図10参照)後の階調画像データを受け取って、画像中に含まれる輪郭の抽出を行う。輪郭の抽出方法には各種方法を採用することができるが、これについては後でまとめて説明する。

【0059】輪郭画素を抽出するとハーフトニング処理を行う(ステップ202)。ハーフトニング処理とは、図10の中でいわゆる多値化処理として説明した処理の中核をなす処理である。すなわち、ハーフトニング処理において、色変換処理された256階調を有する画像データを、カラープリンタ20が表現できるドットの有無で表現された画像データに変換する。本実施例のカラープリンタ20は、大・中・小の3種類のドットを形成することができるので、ハーフトニング処理を行うと、全ての画素について「ドットを形成しない」・「小ドットを形成する」・「中ドットを形成する」・「大ドットを形成する」のいずれかの状態が判断される。ハーフトニング処理にはいわゆる誤差拡散法や粗細的ディザ法等のように、広く知られた種々の方法を使用することができる。本実施例で使用した粗細的ディザ法によるハーフトニング処理については後述する。

【0060】ハーフトニング処理を終了すると、ドットサイズ置換処理を行う(ステップ204)。この処理は、輪郭画素抽出処理(ステップ200)で抽出された画素に所定の大きさのドットが形成されるよう、ハーフトニング処理の判断結果を書き換える処理である。図13にドットサイズ置換処理のフローチャートを示す。既に輪郭画素抽出処理(ステップ200)中で、輪郭画素が抽出され、抽出結果が記憶されているので、今から処理しようとしている画素(注目画素)が輪郭画素であるか否かを初めに判断する(ステップ250)。注目画素が輪郭画素である場合は多値化処理を記憶している値Cdrを「小ドット」の形成を示す値である「1」に書き換える(ステップ252)。注目画素が輪郭画素でない場合はこのように書き換えは行わない。

階調値のベータ領域を印刷する際に該領域内の画素に対してドットが形成される割合をいう。実際には、コンピュータ800のRAM83は、図11のように、階調値に対するドット記録率を各大きさのドット毎に記録したテーブル(ドット記録率テーブル)が記憶されており、原画像の階調値に対して、ドット記録率テーブルに記録されている割合でドットが形成されるように、多値化処理を行っている。また後述するように、本実施例のカラープリンタ20は、多値化処理の中で画像に含まれる形状の輪郭を抽出し、印刷画像の画質を向上させるための特殊な処理も併せて行っている。

【0054】CPU81は多値化処理を終了すると、インターレース処理を開始する(ステップS108)。この処理は、多値化処理によってドットの形成有無を要する形式に変換された画像データを、カラープリンタ20に転送すべき順序に並べ替える処理である。すなわち、前述のようにカラープリンタ20は、キャリッジ40の主走査と副走査を繰り返しながら、印字ヘッド41を駆動して印刷用紙Pの上にドット列(ラスタ)を形成していく。図4を用いて説明したように、各色毎のインク吐出用ヘッド44ないし47には、複数のノズルNzが設けられているので、1回の主走査で複数のラスタを形成することができる。それらラスタは互いにノズルピッチkだけ離れている。ノズルピッチは互いに等しい小さな値とすることが望ましいが、ヘッド製造の都合上、ノズルピッチを画素の間隔(ノズルピッチが1の場合に相当)まで小さくすることは困難である。その結果、画素間隔で並ぶラスタを形成するには、まず、ノズルピッチkだけ離れた複数のラスタを形成し、次にノズル位置を少しずらして、ラスタの間に新たなラスタを形成していくといった制御が必要となる。

【0055】また、印刷画質を向上させるために、1本のラスタを複数の回的主走査に分けて形成したり、更には印刷時間を短縮するために、主走査の往動時と復動時にそれぞれでドットを形成するといった制御も行われる。これらの制御を行うと、カラープリンタ20が実際にドットを形成する順序は、画像データ上で画素の順序と異なった順序となるので、インターレース処理において画像データの並べ替えを行うのである。

【0056】インターレース処理が終了すると、画像データはプリンタが印刷可能な画像データFNLとして、カラープリンタ20に出力される(ステップS110)。

【0057】C. 本実施例における多値化処理
多値化処理の概要については既に説明したが、本実施例のカラープリンタ20では印刷画像の画質を向上させるために、以下に説明する処理を多値化処理の中で併せて行う。以下に説明する処理の内容は、画像に含まれている輪郭を抽出し輪郭部分の画素に小さなドットを形成することであると概括することができ、画像を印刷

こうした処理を全ての画素について行うと(ステップS254)、ドットサイズ置換処理を終了し、第1の多値化処理を抜けて図10に示した画像処理ルーチンに戻ることができる。尚、図13に示したフローチャートでは輪郭画素である場合に、小ドットすなわちカラープリンタ20が形成可能な最も小さなドットを形成しているが、輪郭画素の形成するドットは小さなドットであればよく必ずしも最小ドットである必要はない。本実施例のカラープリンタ20では、大・中・小の3種類のドットが形成可能であるので、小ドットの形成に変えて中ドットを形成するようにしても構わない。

【0061】図14は一例として矢印の図形を印刷した場合に、第1の多値化処理を行うことで印刷画質が改善される様子を示す説明図である。図14(a)は印刷しようにする矢印の形状を示し、図14(b)はハーフトニング処理(図12のステップS202)によって画素毎にドットの形成有無が判断された様子を示す。ここでは、一般的な場合として、真っ黒な矢印を印刷する場合は想定しているので、矢印を構成する各画素の階調値は255となり、対応する各画素には大ドットを形成することを示す値「3」が設定されている。尚、ドットを形成しないことを示す値「0」は、煩雑化を避けるために図示を省略した。図14(c)は本実施例の第1の多値化処理を用いて記録媒体上に形成されたドットの様子を示し、また比較のために、従来の多値化処理(輪郭画素のドットを変更しない多値化処理)を用いて形成されたドットの様子を図14(d)に示す。

【0062】図14(c)と図14(d)とを比較すると、従来の多値化処理を用いて印刷された矢印は角部(CR2)が丸く印刷されているのに対して、本実施例の第1の多値化処理を用いて印刷した場合は、矢印の笠の角部(CR1)が比較的確かな角に印刷されている。また、矢印の輪郭部分についても、従来の多値化処理を用いて印刷した場合は輪(S T2)が太くなってしまっているのに対して、本実施例の第1の多値化処理を用いて印刷した場合は矢印の輪(S T1)が太くなるようなことがない。

【0063】本実施例の第1の多値化処理を行うことによって、図14に示したように画質が改善されるのは次の理由による。図形や文字などは通常、中間階調で表現されることは少なく、従って基本的に大ドットを用いて印刷される。ところが前述したように、カラープリンタではベンディングと呼ばれる現象、すなわち画素の境目で白い影が発生して画質が悪化させる問題の発生を避けるため、大ドットは画素の大きさよりも大きくなるように設定されている。そのため、大ドットを用いて印刷した図形や文字は、ドットが画素より大きく分だけ、縁は太く、角は丸く印刷してしまう。これに対して、本実施例の第1の多値化処理では、図形や文字の輪郭となる画素を抽出し、輪郭部分は小さなドットを用いて印刷

している。このため、図14に示したように縁が太くなくなったり角部が丸くなるといった問題の発生を避けることができるのである。

【0064】(2) 第2の多値化処理

第2の多値化処理は、図形や文字などの印刷画質を更に向上させるため、印刷時の解像度よりも高い解像度の情報が利用できる場合に使用される方法である。印刷時の解像度よりも高い解像度の情報が利用できる場合は、例えば次のような場合である。表やグラフや文字などで構成される画像は、自然画像ほどには豊かな階調表現が必要とされることは少なく、代わりに迅速に印刷することが求められることが多い。このため、図形や文字などの画像を印刷する場合は、画像の解像度を低くすることによって、画質の低下と引き替えに迅速な印刷を行う場合がある。例えば、画像データが主走査方向・副走査方向ともに720dpiの解像度で表現されている場合、主走査方向の解像度を360dpiに低下させて印刷する場合等である。主走査方向の解像度を半分にすれば画像を構成する画素数が半分になるので、図10の画像処理に要する時間が減少する。加えて記録媒体上に形成すべきドットの数も減少するので、印刷時間が大幅に減少させることができる。このような場合は、主走査方向・副走査方向ともに720dpiの解像度の情報が存在しているの

ので、これを利用して本実施例の第2の多値化処理を行えば、印刷画質を犠牲にすることなく迅速な印刷を行うことができる。以下では、画像データが主走査方向・副走査方向ともに720dpiの解像度で表現されているが、主走査方向だけ360dpiに低下させて印刷する場合を例にとり、本実施例の第2の多値化処理について説明する。

【0065】図15は、本実施例の第2の多値化処理の流れを示すフローチャートである。図示するように第2の多値化処理は大きく4つのステップから構成されている。初めに行う低解像度化処理(ステップS300)は、主走査方向の解像度を720dpiから360dpiに低下させる処理である。図10の解像度変換処理(ステップS102)で一且720dpiの解像度に変換されたデータを、主走査方向にだけ360dpiの解像度に変換するのである。ステップS102の解像度変換処理において初めから360dpiに変換しないのは、色変換処理(図10のステップS104)された720dpi解像度のデータを、本実施例の第2の多値化処理中で参照する必要があるからである。また、自然画像については主走査方向も720dpiの解像度で印刷しているの

ので、図形や文字などの画像も一旦720dpiに変換した方が、画像処理上好都合だからである。【0066】図16は、本実施例の低解像度化処理についての説明図である。例として図16(a)の画像を低解像度化する場合を考える。この画像を、主走査方向・副走査方向の解像度が720dpiで、256階調を有

間している。そのため256階調データを補間する場合に比べれば処理が容易になり、また処理に要する時間が短縮することができ、

【0081】図21は、本実施例の第3の多値化処理における補間処理の内容を示す説明図である。例として、図21(a)に示すような画像を補間するものとする。図21(a)に示すような画像を補間する場合、元画像を、一旦、副画像を主走査方向に補間する場合、元画像を、一旦、副走査方向に伸びる複数の画素列に分割し、各画素列の間に新たな画素列を挿入した様子を示している。図中で新たに新たな画素列を挿入した様子を示している。図中で荒く斜線を施した領域Intが、挿入された画素列について、次に、こうして挿入された画素列の各画素について、それぞれの階調値を決定する。図21(c)は、各画素について、それぞれの階調値を決定方法を説明する説明図である。挿入した画素列Intの中のある画素Xにおける階調値を求める場合、画素Xの周辺画素の階調値すなわち画素Y1ないしY6の階調値に基づき、次式を用いて決定する。

(画素Xの階調値) = f (Y1～Y6の各画素の階調値)

ここで、Y1ないしY6の各画素は、大中小の各ドットを形成するか、ドットを形成しないかの4つの階調値を採りうる。階調1の値は実質的に求めることができ、本実施例では、6つの画素が採りうる4階調値の全ての組合せについて、画素Xの階調値を予め決定しROMに記憶してある。ある画素の階調値を求める場合は、まず周辺の6つの画素の階調値を取得し、ROMを参照することによって該当する階調値を決定している。このようにして、図21(b)の各画素を補間すると、最終的に図21(d)に示すような画像が得られる。

【0082】もっとも、画素の階調値を求める際に参照する周辺の画素は6つに限られるものではない。例えば、前述したように6つの周辺画素に加えて、図21(c)中に「y」と付合した10個の画素の階調値を参照すれば、より自然な補間画像を得ることができる。【0083】図20に示すように、本実施例の第3の多値化処理は、補間処理を終了すると階調ドット決定処理を開始する(ステップS406)。これは、ステップS400で抽出した補間画素に形成すべきドットを、補間処理で発生させた階調値の画像データを基に見直し、印刷画質の向上を図る処理である。詳細な処理は、図17に示した第2の多値化処理における階調ドット決定処理と同様であり、以下では、図17のフローチャートを流用して処理の概要を説明する。初めに補間画素を構成する元画素の階調値を取得する(ステップS350相当)。ここで元画素とは補間処理(図20のステップS404)によって補間画素の位置に発生させた2つの画素をいう。2つの元画素の階調値と所定の値(画素t h c nと)を比較して(ステップS352相当)、2つとも大きければドットを形成すると判断し、多値化結果を

表す値C d rに「3」を代入する(ステップS354相当)。左画素の階調値が小さく、右画素の階調値が大きい場合はC d rに「2」を代入し(ステップS356相当)、逆に左画素の階調値が大きく右画素の階調値が小さい場合はC d rに「1」を代入する(ステップS358相当)。このような処理を全ての補間画素について終了すると(ステップS360相当)、階調ドット決定処理を終了し、多値化処理を抜けて、図10の画像処理ルーチンに戻る。

【0084】図22は、本実施例の第3の多値化処理を行うことで印刷画質が改善される様子を示す説明図である。図22(a)は元画像データであり、通常の多値化処理を行って印刷すると図22(b)に示すような画像が得られる。図22(c)は、図21を用いて説明した補間処理の結果を示したものであり、本実施例の第3の多値化処理を行って得られた印刷画像が図22(d)に示す画像である。図22(d)を見れば明らかな通り、補間して得られた高解像度の情報に基づいて、大中小の各ドットを打ち分けた結果、画像の輪郭が滑らかな輪郭に改善されている。

【0085】尚、上述の説明では、中・小ドットのドット形成位置がずらして設定されているものとして説明したが、中・小ドットを同位置に重ねて形成したとしても、画質改善の効果が得られることは、先に説明した第2の多値化処理の場合と同様である。

【0086】D. 補間画素の抽出処理

以上説明してきた実施例では、互いに隣接する画素の階調値に基づいて補間差を抽出している。図23は、本実施例で用いた補間画素抽出処理の内容を示す説明図である。図23(a)に示すように、補間画素であるか否かを判断しようとする注目画素P cと、その前後にある前方参照画素P r bおよび後方参照画素P r aとを1組とし、3つの画素の組をまとめて主走査方向に動かしながら、各画素の階調値に基づいて注目画素が補間画素であるか否かを判断するのである。以下、図23(b)ないし図23(d)を用いて具体的に説明する。

【0087】図23(b)ないし図23(d)は、図14の矢印の画像を多値化処理する前の、256階調を有する画像データであり(図10参照)、煩雑さを避けるために、階調値の高い画素は斜線で、階調値の低い画素は白抜きでしてある。例えば注目画素P cが図23(b)のD1で示した画素にある場合、前方参照画素の階調値は高階調値となっているが、注目画素の階調値は低階調値であるから、画素D1の位置は補間位置ではないと判断できる。注目画素が主走査方向に1画素だけ移動して画素D2にきた場合は(図23(c)の状態)、前方参照画素P r bと注目画素P cの階調値が共に高階調値となるので、画素D2は補間位置にあるものと判断することができる。更に1画素だけ動いて画素D3に来ると(図23(d)の状態)、注目画素P cおよび前後

の参照画素の階調値と共に高階調値となるので、画素D3は補間位置の内部にあるものと判断できる。【0088】注目画素・前方参照画素・後方参照画素のそれぞれ階調値の組合せと、注目画素が補間画素であるか否かの判断結果をまとめて図24(a)に示す。図24(a)とあるのは画素の階調値が高階調値であることと、「H」とあるのは低階調値であることを表している。画素の階調値が高階調値であるか否かは、後述のフローチャートに示すように、所定の階調と比較することによって判断する。判断結果の値「0」は注目画素が補間画素でないことを示す。判断結果の値「1」あるいは「2」は、注目画素が補間画素であることを示している。補間画素である場合に判断結果が「1」または「2」の2つの値を採りうるのは、注目画素の位置から図形が始まる状態、すなわち注目画素と前方参照画素が図形に含まれ後方参照画素が図形に含まれない状態と、注目画素で図形が終る状態、すなわち注目画素と後方参照画素が図形に含まれ前方参照画素が図形に含まれない状態とを区別しているからである。また、図24(a)中に「-」とあるのは、注目画素が画像の端の端部にある場合などのように、対応する階調値が存在しないことを示している。この表に従って、例えば図23(b)に示した画像の補間画素を抽出すると、図24(b)に示すような結果が得られる。尚、図24(b)で煩雑さを避けるために、判断結果の値は補間画素についてのみ表示している。

【0089】図25は、第1ないし第3の多値化処理中における補間画素抽出処理の流れを示すフローチャートである。補間画素抽出処理を開始すると、初めに注目画素が画像の端部に位置しているか否かを判断する(ステップS500)。注目画素が画像の端部にある場合は、補間画素の抽出を行わないこととして判断結果の値C c nに「0」を代入する(ステップS502)。注目画素が画像の端部にない場合は、実際に補間画素の抽出処理を行うために、注目画素・前方参照画素・後方参照画素のそれぞれの階調値V c・V r b・V r aを取得する(ステップS504)。先ず注目画素の階調値V cと所定の階調t h c nとの大小関係を比較し(ステップS506)、階調値V cが階調t h c nより小さい場合は注目画素は補間画素ではないと判断して、判断結果を示す値C c nに「0」を代入する(ステップS508)。階調値t h c nの値は最終的には印刷画質を見ながら選定されるが、ハーフトーニング処理中で大ドットの形成判断に使用される階調値付近の値を目安として使用することができる。ハーフトーニング処理の詳細については後述する。

【0090】階調値V cが階調t h c nより大きい場合、注目画素は図形の輪郭上にあるか図形の内部にあるかのいずれかであると考えられる。図24(a)を参考にすれば、このような場合、少なくとも後方参照画素の階調値V cが階調t h c nより大きい場合は、ある画素に辺で接するか、あるいは対角線で接する合計8つの画素をいう。上述の例において、4近傍の画素に代えて8近傍の画素を参照するようにしても構わないのはもちろんである。

階調値が「L」であれば注目画素は「1」であることが分かる。そこで、後方参照画素の階調値V r aと階調t h c nとの大小を比較し(ステップS510)、V r aが階調t h c nより小さければ判断結果の値C c nに「1」を代入する(ステップS512)。V r aが階調t h c nより大きい場合は、前方参照画素の階調値V r bと階調t h c nの大小を比較し(ステップS514)と、V r bが階調t h c nより小さければ判断結果C c nに値「0」を代入する(ステップS516)。つまり、注目画素・後方参照画素・前方参照画素の階調値がいずれも階調t h c nより大きいことから、注目画素が図形の内部にあると判断するのである。また、前方参照画素の階調値V r bが階調t h c nより小さければ、判断結果C c nに値「2」を代入する(ステップS518)。注目画素・後方参照画素は図形に含まれているが、前方参照画素は図形に含まれていないと判断できるからである。以上のよう

な判断を全ての画素について行うと(ステップS520)、補間画素抽出処理を終了して、それぞれの多値化処理(図12、図15、図20)に戻る。

【0091】以上説明してきた補間画素の抽出処理は、注目画素を挟んで左右の画素の階調値を参照するが、注目画素から4近傍に隣接する画素を参照する以外にもよい。図26はこのような補間画素抽出処理の概要を説明するための概念図である。4近傍の画素とはある画素に辺で接する4つの画素のことをいう。図26(a)は注目画素に隣接する4近傍の画素を示した説明図である。

【0092】4近傍の画素を参照して補間画素を抽出する方法は、前述した方法と同様の原理により行うことができる。すなわち、注目画素が画像の端部にある場合、注目画素の階調値が低階調値である場合、および4近傍の画素の階調値が全て高階調値となる場合は、いずれも注目画素は補間画素ではないと判断する。注目画素が高階調値となり、かつ4近傍の画素の中の1つないし3つが高階調値となるときは、注目画素は補間画素であると判断できる。図形が始まる場合は、注目画素の上下に隣接する画素を前方参照画素に準じて扱えばよい。

【0093】図23(b)に示す画像から、4近傍の画素を参照して補間画素を抽出すると、図26(b)に示すような結果が得られる。図24(b)の抽出結果と比較してみれば、4近傍を参照して補間画素を抽出した場合は、例えば矢印の三角形の底辺部分の輪郭も正確に抽出され、その結果、印刷画像の品質が更に向上することが分かる。尚、「近傍」という概念には、4近傍の他に8近傍と呼ばれる概念があることも広く知られている。例えば8近傍の画素とは、ある画素に辺で接するか、あるいは対角線で接する合計8つの画素をいう。上述の例において、4近傍の画素に代えて8近傍の画素を参照するようにしても構わないのはもちろんである。

- 【0094】E. 組織的ディザ法によるハーフトーン処理
- 最後に、本実施例で使用したハーフトーン処理について簡単に説明しておく。前述の輪郭面抽出処理中で用いられる閾値 th_{en} の値は、以下のハーフトーン処理で、大ドットの形成有無を判断するために使用される閾値の値を参考にして選択されている。尚、ハーフトーン処理においては種々の方法が知られており、本実施例においては、以下に説明する方法に限らず、それら各種の方法を適用することができる。
- 【0095】図27は、プリンタドライバ92が、組織的ディザ法と呼ばれる方法を用いてハーフトーン処理を行うフローチャートである。本実施例では、C・M・Y・Kの各色毎にハーフトーン処理を並行して行っているが、説明の簡潔化を避けるために、以下の説明では、色を特定せずに説明する。
- 【0096】ハーフトーン処理を開始すると、CPU8は画像データCを読み込む(ステップS600)。この画像データCは、色変換後の256階調を有する各色毎の画像データである。次に、前述した図11のドット記録率テーブルを参照して、画像データCに対する大・中・小の各ドットのドット記録率 R_{dl} 、 R_{dm} 、 R_{ds} を一度に取得する(ステップS602)。尚、ドット記録率 R_{dl} は、全ての画素にドットが形成されている状態をドット記録率 $R_{dl} = 2.55$ と定義されている。これは、コンピュータ80がデータ $8b$ i で表現することに起因するデータ処理上の都合によるものである。
- 【0097】次に、大ドットのドット記録率 R_{dl} と第1の閾値 th_1 との大きさを比較し(ステップS604)、大ドットのドット記録率 R_{dl} の方が大きければ、多値化結果Cdrに大ドットを形成することを意味する値「3」を代入する(ステップS606)。第1の閾値 th_1 は、ディザマトリックスによって各画素毎に異なる値が設定されている。
- 【0098】ここで、図28を用いることにより、組織的ディザ法によるハーフトーン処理の考え方を説明しておく。説明を簡略化するために、図28では、画像データの一部分(4×4の画素)のみを取り出して表している。組織的ディザ法を用いて、例えば縦・横1000×1000の画素からなる画像データCdrを多値化する場合に、同じ大きさ(縦・横1000×1000)のディザマトリックスを用意し、ディザマトリックスの各画素に0～255の閾値をランダムに設定しておく。そして画像データの階調値とディザマトリックスの閾値とを、位置の対応する画素毎に比較し、画像データの階調値がディザマトリックスの閾値より大きければその画素値がドットを形成する。逆に小さければドットを形成しないと判断するものである。図28には、対応する画素毎に、画像データの階調値とディザマトリックスの閾値と

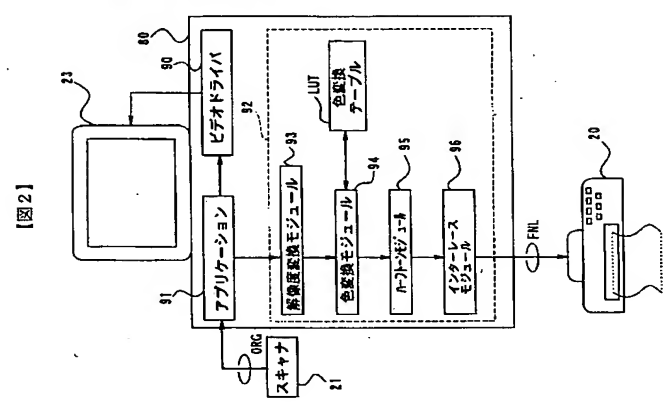
- と、全ての画素について、ドットの判断を終了すると(ステップS618)、ハーフトーン処理を終了する。
- 【0102】以上、各種の実施例について説明してきたが、本発明は上記すべての実施例に限られるものではなく、その要旨を逸脱しない範囲において種々の態様で実施することができる。例えば、上述の機能を実現するソフトウェアプログラム(アプリケーションプログラム)を、通信回線を介してコンピュータシステムのメインメモリまたは外部記憶装置に供給し実行するものであってよい。
- 【図面の簡単な説明】
- 【図1】本実施例の印刷装置の概略構成図である。
- 【図2】ソフトウェアの構成を示す説明図である。
- 【図3】本実施例のプリンタの概略構成図である。
- 【図4】本実施例のプリンタにおけるドット形成原理を示す説明図である。
- 【図5】本実施例のプリンタにおけるノズル配列を示す説明図である。
- 【図6】本実施例のプリンタにより大きさの異なるドットを形成する原理を説明する説明図である。
- 【図7】本実施例のプリンタにおけるノズルの駆動波形および駆動波形状により形成されるドットの様子を示す説明図である。
- 【図8】本実施例のプリンタの制御装置の内部構成を示す説明図である。
- 【図9】本実施例のプリンタヘッドが駆動パルスからデータを受けてドットを形成する様子を示す説明図である。
- 【図10】本実施例における画像処理ルーチンの流れを示すフローチャートである。
- 【図11】本実施例で用いられるドット記録率テーブルの一例を示す説明図である。
- 【図12】本実施例の第1の多値化処理の流れを示すフローチャートである。
- 【図13】本実施例の第1の多値化処理におけるドットサイズ値処理の流れを示すフローチャートである。
- 【図14】本実施例の第1の多値化処理による画質改善効果を示す説明図である。
- 【図15】本実施例の第2の多値化処理の流れを示すフローチャートである。
- 【図16】本実施例の第2の多値化処理における低解像度処理を示す説明図である。
- 【図17】輪郭ドット決定処理の流れを示すフローチャートである。
- 【図18】記録媒体上に形成される小ドット、中ドット、および大ドットの位置関係の一例を示す説明図である。
- 【図19】本実施例の第2の多値化処理による画質改善効果を示す説明図である。

- 【図20】本実施例の第3の多値化処理の流れを示すフローチャートである。
- 【図21】本実施例の第3の多値化処理における補間処理の概要を示す説明図である。
- 【図22】本実施例の第3の多値化処理による画質改善効果を示す説明図である。
- 【図23】輪郭面抽出処理の概要を示す説明図である。
- 【図24】輪郭面抽出のために参照される各画素の階調値と、輪郭面が否かの判断結果をまとめた説明図である。
- 【図25】輪郭面抽出処理の流れを示すフローチャートである。
- 【図26】4近傍の画素を参照して輪郭面を抽出する方法を説明する説明図である。
- 【図27】本実施例において用いられるハーフトーン処理の流れを示すフローチャートである。
- 【図28】組織的ディザ法によるハーフトーン処理の概要を説明する説明図である。
- 【符号の説明】
- 20…カラープリンタ
21…カラーキャナ
23…CRT
24…モデム
25…フレキシブルディスクドライブ
26…ハードディスク
30…キャリッジモータ
31…駆動ベルト
32…プーリ
33…駆動軸
34…位置検出センサ
35…紙送りモータ
36…ブラデン
40…キャリッジ
41…CPU
41…印字ヘッド
42、43…インクカートリッジ
44～47…インク吐出用ヘッド
50…インク通路
59…操作パネル
60…制御回路
61…CPU
62…PROM
63…RAM
64…PCインターフェース
66…タイマ
67…駆動バンプ
68…バス
69…分配力器
70…発振器

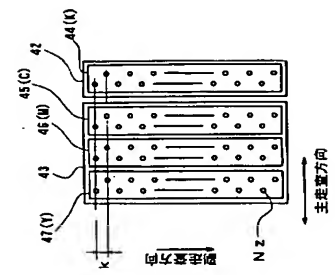
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- 80...コンピュータ
- 81...CPU
- 82...ROM
- 83...RAM
- 84...入力インターフェース
- 85...出力インターフェース
- 86...CRTC
- 87...DDC
- 88...SIO
- 89...バス
- 90...ビデオドライバ
- 91...アプリケーションプログラム
- 92...プリンタドライバ
- 93...解像度変換モジュール
- 94...色変換モジュール
- 95...多値化モジュール
- 96...インターレースモジュール

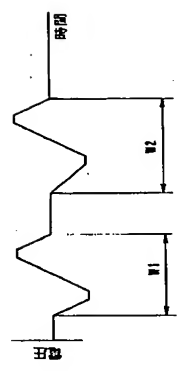
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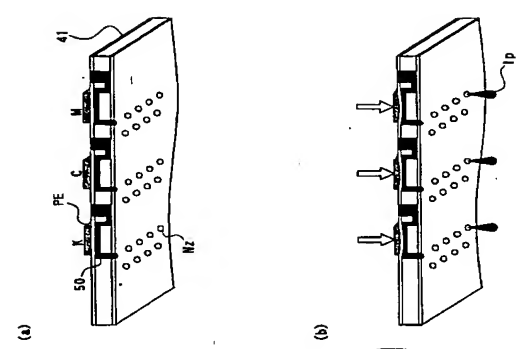
【図5】



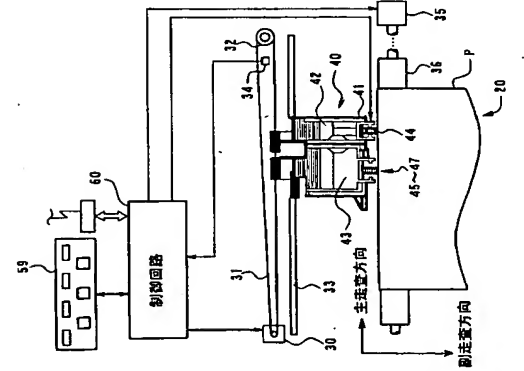
【図7】



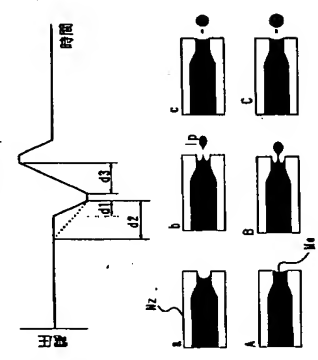
【図4】



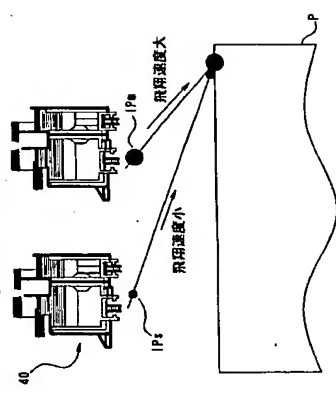
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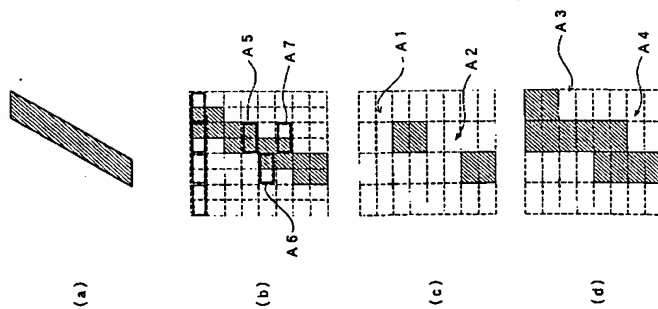
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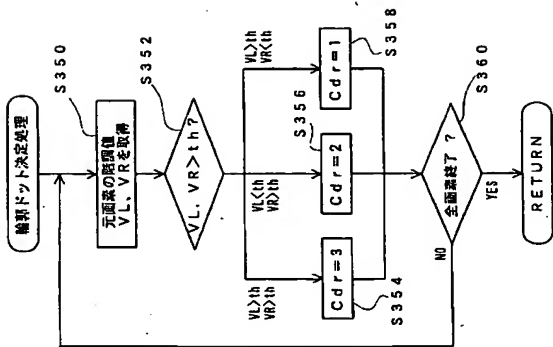
【図7】



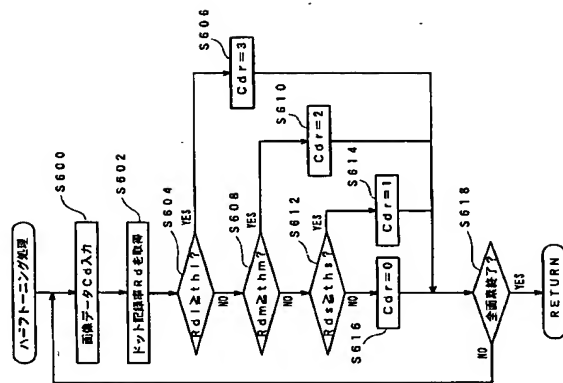
【図16】



【図17】

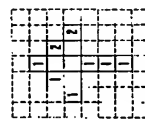


【図27】

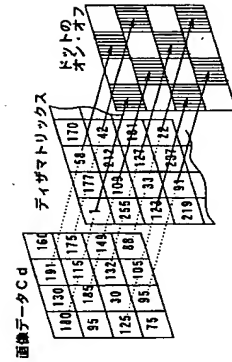


【図24】

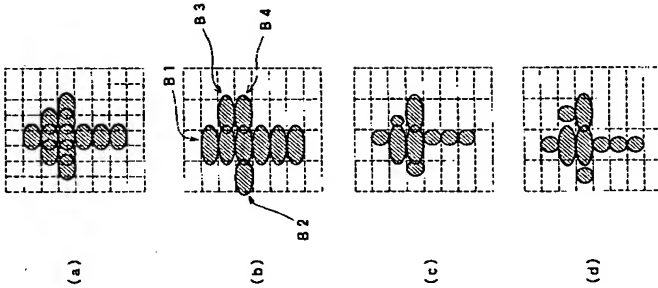
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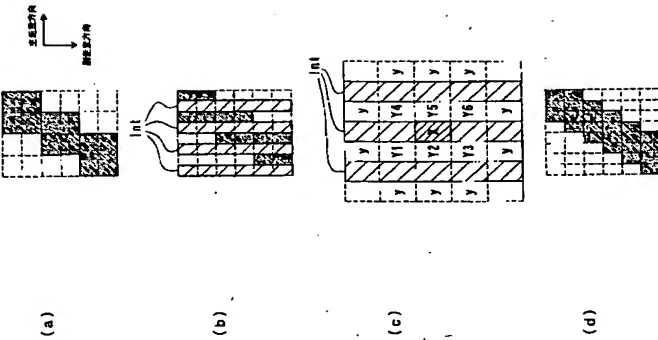
【図28】



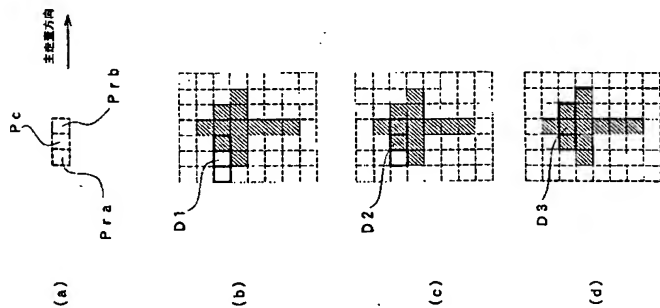
【図19】



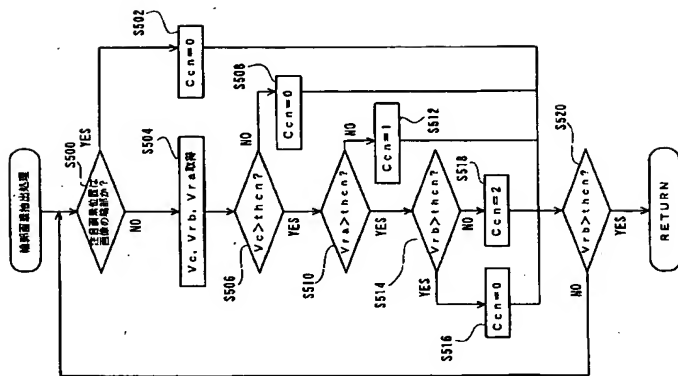
【図21】



【図23】



【図25】



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